

SCIENCE-X

MODULE -6

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HEREDITY AND EVOLUTION

HEREDITY AND VARIATIONS

It is commonly seen that members of a species are largely alike. An elephant resembles other elephants, a rose plant looks alike other rose plants, and children resemble their parents, even grandparents or great grandparents. This resemblance among the individuals of a species has given rise to a general truth '**like begets like**' which implies continuity of life. It is, however, not absolutely true as the members of a species are seldom exactly alike. For instance, in human beings, the children often have some individual characters in which they differ from one another, and also from their parents. In fact, their differences are as marked as their resemblances. This is true about other species as well.

	ON YOUR TIPS	
Genetics is a branch of biology deals with the study of heredity and variation.		

The similarities and differences among the members of a species are not coincidental. They are received by the young ones from their parents. The hereditary information, in fact, is present in the gametes (egg and sperm) which fuse to form the fertilized egg or zygote during sexual reproduction. The zygote then develops into an organism of a particular type. For instance, fertilized eggs of sparrows hatch into sparrows only and the fertilized eggs of pigeons hatch into pigeons only. Similarly, a cow gives birth to calves only. The wheat plant gives rise to seeds which, in turn, develop into wheat plants.

A Little further 2.1
Why do bacteria look alike ?
Explanation
Because they reproduce by asexual mode of reproduction.

Heredity :- The transmission of characters [or traits] from one generation to another generation.

OR

The transmission of characters from the parents to their offsprings.

Variations :- The differences in the characters [or traits] among the individuals of a species are called variations. **e.g. Plant height** - Tall, dwarf & middle.

Ear lobe in human being :- The lowest part of our ear is called earlobe.

- ◆ In most of the people, the ear lobe is hanging and it is called free earlobe.
- ◆ In some people, the earlobe is closely attached to the side of the head and it is called attached ear lobe.



ACCUMULATION OF VARIATIONS DURING REPRODUCTION

Heredity involves inheritance of basic body design (similarities) as well as subtle changes (variations) in it from one generation to the next generation, i.e., from parents to the offspring. When individuals of this new generation reproduce, the offsprings of second generation will have the basic body design, the differences that they inherit from first generation as well as newly developed differences.

Asexual reproduction involves single parent. When a single individual reproduces asexually, the resultant two individuals again after sometime reproduce to form four individuals. All these individuals would be similar. However, there would be only very minor differences between them. These very minor differences arise due to small inaccuracies in **DNA** copying.





Sexual reproduction, on the other hand, generates even greater diversity. This is so because sexual reproduction involves two parents (father and mother) and every offspring receives some characters of father and some characters of mother. Since, different offsprings receive different combination of characters of their parents (father and mother), they show distinct differences (variations) among themselves as well as from their parents. The variations accumulate and pass on to more and more individuals with each generation.

	ON YOUR TIPS	
The differences in the characters [or traits] among the individuals of a species are called variations. e.g. Plant height-Tall, dwarf and middle.		

During sexual reproduction the variation caused by –

- (i) Chance separation of chromosomes during gamete formation (gametogenesis).
- (ii) Crossing over during meiosis.
- (iii) Chance coming together of chromosomes during fertilization.
- (iv) Mutations, i.e., alterations in the genetic material.

All the variations in a species do not have equal chances of surviving in the environment in which they are generated. Depending upon the nature of variations, different individuals would have different kinds of advantages. For instance, bacteria that can withstand heat will survive better in a heat wave than the others. In other words, environmental factors select the variants and this selection forms the basis of evolution.

	ON YOUR TIPS	
Unit of heredity which transfers characters from parents to their offsprings during reproduction is called genes. Gene → Protein synthesis → Enzymes [controls phenotype of a character]		

GREGOR JOHANN MENDEL (1822 - 1884)

Mendel was born on 22 July 1822 at Heinzendorf in Austria at Silesia village. Mendel was worked in Augustinian Monastery as monk at Brun city, Austria.

In 1856-57, he started his historical experiments of heredity on pea (**Pisum sativum**) plant. His experimental work continued on pea plant till 1865 (19th century).

The results of his experiments were published in the science journal. "**Nature For Schender Vairein**" in 1866.

This journal was in German language. Title is '**Vershue Uber Pflangen Hybridan**'.

This journal was published by '**Natural History society of Bruno**'.

A paper of Mendel by the name of **Experiment in plant Hybridization** published in this journal.



Mendel were unable to got any popularity no one understand of him. He died in 1884 (due to kidney disease (Bright disease)) without getting any credit of his work.

After 16 years of Mendel's death in 1900 Mendel's postulates was rediscovered. Mendel experiment remain hidden for 34 years.



Rediscovery by three scientist independently.

1. **Carl Correns** - Germany - (Experiment on Maize)
2. **Hugo deVries** (Holland) (Experiment on Evening Primrose)
3. **Erich von Tschermak Seysenegg** - (Austria) (Experiment on different flowering plants)

	ON YOUR TIPS	
In Homozygous condition two factors of a character are same (TT). In Hybrid/Heterozygous condition. 2 factors of a character are different (Tt).		

CHARACTER

A recognizable feature of human beings or any other organisms are called characters.

eg. (i) Height (ii) Complexion (iii) Shape of hair (iv) Colour of eyes (v) Shape of nose

Traits :- Various forms of a character are called **traits**.

S. No.	Character	Dominant	Recessive
1.	Length of Plant	Tall	Dwarf
2.	Flower position	Axial	Terminal
3.	Shape of pod	Inflated	Constricted
4.	Colour of pod	Green	Yellow
5.	Shape of seed	Round	Wrinkled
6.	Colour of cotyledon	Yellow	Green
7.	Colour of flower	Violet	White

PRACTICE ZONE 2.1

1. If a trait A exists in 10% of a population of an asexually reproducing species and a trait B exists in 60% of the same population, which trait is likely to have arisen earlier?
2. How does the creation of variations in a species promote survival?
3. What is the role of DNA for bringing variation?

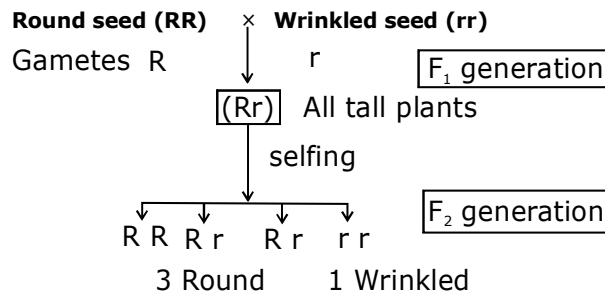
MENDEL'S MONOHYBRID CROSS

A breeding experiment dealing with **a single character is called a monohybrid cross.**

Mendel first selected '**pure line**' plants (i.e., the plants that produced similar traits generation after generation). He, then, cross pollinated such plants having the contrasting traits, considering one trait at a time. For instance, in one such cross breeding experiment, he cross bred garden pea plant having round seeds with plant having wrinkled seeds. In this monohybrid cross, the pollen grains from the flower of the desired plant raised from round seeds were transferred over the previously emasculated flower of a plant raised from wrinkled seeds or vice-versa. After the transfer of pollen grains, the cross pollinated flower was properly covered and seeds produced were allowed to mature. All the seeds of **F₁ generation** were carefully observed. Mendel observed that all the seeds of F₁ generation were of round type and there were no intermediate characteristics.

He raised plants from F₁ seeds and allowed the flowers to self-pollinate to produce the seeds of F₂ generation. The flowers were kept covered from the beginning to avoid unwanted pollens to reach these flowers. In F₂ generation, Mendel observed the appearance of both round and wrinkled seeds in approximately 3 : 1 proportion.



**Fig. 1 Monohybrid cross****PRACTICE ZONE****2.1**

- The trait B has arisen earlier since it is in 60% population while trait A is merely in 10% which is newly arisen and not spread to large number.
- Creation of variation may be suitable for a population to fight against some new change in environment while those which do not have this variation will not be able to fight with such changing conditions and will die.
- DNA is the molecule which has heredity information stored in it, DNA can make its own copy by replication but sometimes this replication brings errors, which shows variation in expression of their respective characters.

MENDEL'S DIHYBRID CROSS

A cross involving two pairs of contrasting characters.

OR

A cross in which two pair of contrasting characters are studied at a time.

In one such cross, Mendel considered **shape** as well as **colour of the seeds** simultaneously. He selected pure line plants and then cross pollinated flowers raised from seeds of round shape and yellow colour with those from wrinkled seeds and green colour. Mendel observed that in F_1 generation all seeds had the features of only one parental type, i.e., round shape and yellow colour. He raised plants from F_1 generation seeds and allowed the flowers to self pollinate to produce the seeds of F_2 generation. These flowers were kept covered from the beginning. In F_2 generation, Mendel observed the appearance of four types of combinations. These included two **parental types** (round shaped and yellow coloured seeds, and wrinkled shaped and green coloured seeds) and **two new combinations** (round shape and green coloured seeds, and wrinkled and yellow coloured seeds) in approximately same proportion.

Yellow & Round seeds $RRYY$ Green & Wrinkled seeds $rryy$

Gametes RY ry

$RrYy \times RrYy$

Gametes RY Ry rY ry

	RY	Ry	rY	ry
RY	RRYY Round Yellow	RrYY Round Yellow	RrYY Round Yellow	RrYy Round Yellow
Ry	RRYy Round Yellow	Rryy Round Green	RrYy Round Yellow	Rryy Round Green
rY	RrYY Round Yellow	RrYy Round Yellow	rrYY Wrinkled Yellow	rrYy Wrinkled Yellow
ry	RrYy Round Yellow	Rryy Round Green	rrYy Wrinkled Yellow	rryy Wrinkled Green

Fig.2 Dihybrid cross

SOME IMPORTANT DEFINITIONS

Dominant gene :- The gene which decided the appearance of an organism even in the presence of an alternative gene.



Recessive Gene :- The gene which can decide the appearance of an organism only in the presence of another identical gene.

Chromosomes :- A thread - like structure in the nucleus of a cell formed of DNA which carries the genes.

Genotype :- The genetic constitution of an organism.

OR

The description of genes present in an organism e.g. TT, tt, Tt.

	ON YOUR TIPS	
Central dogma : A character is expressed by following way since a gene is made up of DNA which make which may act as an enzyme to express a character.		

Phenotype :- External and morphological appearance of an organism for a particular character.

Allele :- Alternative forms of a gene which are located on same position [loci] on the homologous chromosome.

F₁ Generation :- When two parents cross or breed to produce progeny [or offsprings], then their progeny is called F₁ generation or first filial generation.

OR

The offspring produced by the parental generation.

F₂ generation :- When the first generation progeny cross or breed among themselves to produce second progeny, then this progeny is called second filial generation or F₂ generation.

OR

The offspring produced by the F₁ generation

Hybrid :- A new form of plant resulting from a cross or breeding of different varieties of a plant is known as a hybrid.

Pure-breeding :- Characteristics that appear unchanged generation after generation.

Dominant characters :- Any character that appears in the F₁ generation offspring from a cross between parents possessing contrasting characters such as tallness & dwarfness in pea plants.

Recessive characters :- Any character present in the parental generation that does not appear in the F₁ generation but reappears in the F₂ generation.

Homozygous :- A condition in which the 2 members of an allelic pair are similar. **e.g.** TT, tt.

Heterozygous :- A condition in which the 2 members of an allelic pair are dissimilar. **e.g.** Tt.

Offspring :- Organisms produced as a result of sexual reproduction.

Homologous chromosomes :- All chromosomes found in pair & chromosomes of a pair are called homologous chromosomes.

Non-homologous chromosomes :- Chromosomes of different pair are called non-homologous chromosomes.

Genes :- Unit of heredity which transfers characters from parents to their offsprings during reproduction.

Gene → Protein synthesis → Enzymes [Controls phenotype of a character]



A Little further 2.2

How a character is expressed ?

Explanation

A function is controlled by formation a specific enzyme, this enzyme is then leads to a specific chemical reaction to express it's character.

If we consider the hybrid condition obtained by Mandel in F₁ generation, it has both "T" and "t", yet it shows tallness not dwarfness. There are two possible reasons for it as follows-

- (a) It may not be able to make its enzyme, so its character is not expressed.
- (b) It's enzymes are not be in enough quantity to show its expression in presence of enzyme of "T".

LAWS OF MENDEL/LAWS OF INHERITANCE

On the basis of Mendel's work, 3 basic laws of inheritance were proposed.

- (i) Law of Dominance
- (ii) Law of Segregation
- (iii) Law of Independent Assortment

Law of dominance :- In crossing between organisms pure for contrasting characters of a pair, only one character of the pair appears in the F₁ generation. This character is termed dominant while the one which does not express itself in F₁ generation is termed recessive.

Law of segregation :- Allele or genes remain together and segregate at the time of gamete formation. This means that the alleles don't mix in the hybrids [Non-mixing of alleles]

This is also known as the **Law of Purity of Gametes**.

Law of Independent Assortment :- This law states that - when individuals differing in 2 or more than 2 pairs of contrasting characters are crossed, the inheritance of any one pair is not affected by the presence of the other.

e.g. The inheritance of tall character is not way related to the smooth character of the seed. Rather, the 2 characters are inherited independent of each other.

Advantage of *pisum sativum*

Pisum sativum was a unique plant selected by Mendel for his experimentations had following importance-

Property	Advantages of properties
a. Short life cycle	Results of experiments were obtained in less time.
b. Could be grown throughout year	More experiments can be done in a year.
c. Choice of cross or self fertilization	Mandel could conduct experiment as per his desire.
d. 7 pairs of allelic characters	Large number of choice for experiments.
e. Large number of offspring	Good number of data for statistical analysis.



SEX DETERMINATION

How is the sex of newborn individual determined ? In human beings, the sex of the individual is largely genetically determined. In other words, the genes inherited from our parents have assumed that similar gene sets are inherited from both parents. If that is the case, how can genetic inheritance determine sex ?

All human beings these are 23 pairs of chromosomes are present out of these 23 pairs, are autosomes (similar in males and females) and 1 pair is called sex chromosome (different in males and females). In males sex chromosome are XY and in females sex chromosome are XX.

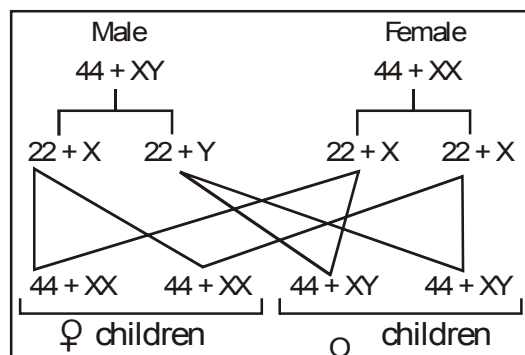


Fig.3 Sex determination

So, it is clear from the above that male is responsible for producing male child.

- ✦ The term Genetics comes from "gene" word – means "to grow".
- ✦ The term "Genetics" coined by **Bateson**.
- ✦ Study of *heredity and variations* is called **Genetics**.
- ✦ Father of Genetics - **Gregor Johann Mendel**.
- ✦ Father of Modern Genetics - **Bateson**.
- ✦ Father of Experimental Genetics - **Thomus Hunt Morgan**.
- ✦ "Heredity" term coined by **Spencer**.
- ✦ Bateson coined terms Genetics, Allele, Homozygous, Heterozygous, F_1 and F_2 Generation.

DEOXYRIBONUCLEIC ACID (DNA)

The expanded form of DNA is deoxyribonucleic acid. It was first isolated by the scientist **Frederick Meisher** from the nucleus of the pus cells in 1869. He named it as '**nuclein**' or nucleic acid because of its acidic nature. Later, it was experimentally proved by the scientists **Griffith (1928)**, **Avery, McLeod and McCarty (1944)** that DNA is the carrier of the genetic information from generation to generation. It transmits the hereditary characters in a coded language from parents to the offsprings (i.e., from one generation to another).

DNA is a macromolecule or polymer. It is made of very large number of 'nucleotide' units and hence is termed **polynucleotide**.

Each nucleotide unit in a DNA molecule is made up of three components

1. **Deoxyribose sugar** :- It is a pentose sugar.
2. **Nitrogenous base** :- Each nucleotide unit has a nitrogen containing base. In a DNA molecule, nitrogenous bases are of two types :
 - (a) **Purines** :- The purines in a DNA molecule are — **Adenine (A)** and **Guanine (G)**.
 - (b) **Pyrimidines** :- The pyrimidines in a DNA molecule are — **Cytosine (C)** and **Thymine (T)**.
3. **Phosphate group** :- The phosphate group contains one phosphorus atom and four specifically linked oxygen atoms.

Thus, there are four types of nucleotides in a DNA molecule depending upon the kind of nitrogenous base present in **each** nucleotide.



Double Helical Model of DNA

J. D. Watson and **F.H.C. Crick** proposed the double helical model of **DNA** in **1953**. They were awarded the **Nobel Prize** for this discovery in **1962**. The important features of the double helical model are

(i) DNA molecule is made up of two **long polynucleotide strands** forming a **double helical structure (double helix)** just like a spiral staircase. Each helical turn of the DNA molecule is **3.4 nm** in length in which **ten nucleotide** base pairs are present.

(ii) **Deoxyribose sugar and phosphate molecules** are joined alternately to form the backbone of each polynucleotide strand. The **nitrogenous base** of each nucleotide is attached to the sugar molecule and projected towards the interior of the double helix.

(iii) In the interior of double helix, the nitrogenous bases of two polynucleotide strands form a pair with the help of hydrogen bonds. **Adenine (A)** always pairs with **thymine (T)** and **guanine (G)** always pairs with **cytosine (C)**.

Thus, the two polynucleotide strands of the DNA molecule are joined by *hydrogen bonds between specific nitrogenous bases*. **Such a specific pairing of the bases of the opposite strands of the DNA molecule is called complementary pairing. Adenine (A) and thymine (T) are complementary to each other. Similarly, guanine (G) and cytosine (C) are complementary to each other.** The hydrogen bonding between the specific nitrogenous bases keeps the two strands to hold together. Therefore, all the base pairs remain stacked between the two strands.

BLOOD GROUPS

Four different types of blood groups in human beings are : A, B, O, AB

O → universal donor

AB → universal recipient

Blood group	Genotype	Dominant	Recessive	Antigen	Antibody
A	$I^A I^A$ $I^A I^O$	I^A	I^O	A	B
B	$I^B I^B$ $I^B I^O$	I^B	I^O	B	A
AB	$I^A I^B$	I^A, I^B	–	A, B	–
O	$I^O I^O$	–	I^O	–	AB

EVOLUTION

The term evolution has been derived from the Latin word '**evolvere**' means unroll.

Evolution can be defined as sequence of gradual development of complex form of life from simple form of life over the course of geological time " Descent with modification."

Evolution is of two types –

- (i) Chemical evolution
- (ii) Organic evolution.



S.No.	Features	Chemical evolution	Organic evolution
1	Definition	It is the formation of the complex organic compounds from simple compound or element	It is the formation of complex form of life from simple form of life.
2	Time of occurrence	It occurred at the time of origin of life	It is still occurring
3	Reversibility	Irreversible	Reversible
4	Speed of evolution	It is fast process	It is a slow process
5	Index was given by	A.I oparin	Charles Robert Darwin



Organic evolution :

After origin of a living cell the next questions that arose was how did so many different species of complex life form come into existence? Here are various view points.

Carolus linnaeus :- Said that no species is new i.e. each species originates from pre existing species.

Jeans baptist lamarck :- Explained in his book namely **philosoophie zoologique, the theory of inheritance of acquired characters or lamarkism**. This theory states that use and disuse of an organ leads to change in the organ. Which is inherited by the offsprings. The favourable variations which remain for longer period of time results in evolution of new species.

This theory was discarded by **August Weismann** as he experimentally proved that even after cutting tails of mice for 21 generation tailless mice was never born.

	ON YOUR TIPS	
Hoekel propounded "The theory of recapitulation" or 'Biogenetic law' which states that an individual organism in its development tends to repeat the stages passed through by its ancestors (phylogeny).		

DARWINISM

Charles Robert Darwin was born on 12 Feb, 1809 in England. He travelled by **HMS Beagle** ship along with **Dr. Henslow**. He visited many islands of south America, South Africa, Australia and Galapagos Islands. Darwin was influenced by two books. "**Principal of population**" of malthus. "**Principal of Geology of charls leyell**."

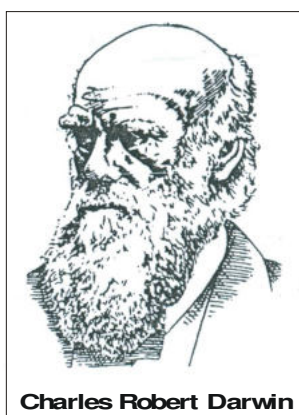


Fig.4

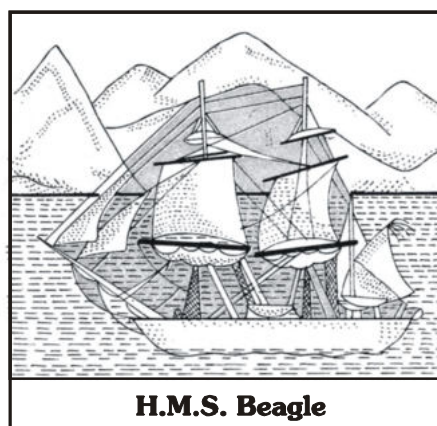


Fig.5

In his book **origin of species** he answered this questions. The theory presented by him is called **theory of natural selection or Darwinism**.

A Little further 2.3

What are the basic events in evolution ?



Explanation

A gradual genetic change in a group of living beings to produce new forms brought about by changes in DNA during reproduction are the basic events of evolution.

Alfred Russel wallace :- He travelled south eastern Asia and south America. The idea of natural selection struck in his mind wallace wrote an essay and sent it to Darwin. **On the tendency of varieties to depart indefinitely from original type**. There is striking similarity between the views of Darwin and Wallace.

S.No.	Facts	Consequences (conclusions)
1.	(i) Enormous rate of reproduction among animals. (ii) Constant number of animals of a species.	Struggle for existence
2.	(i) Struggle for existence (ii) Heritable variations	Survival of the fittest or natural selection
3.	(i) Survival of the fittest (ii) Continues environment changes	Continuous natural selection leading to evolution of new species

Charles Darwin explained the mechanism of origin of new species by natural selection. But he failed to explain the mechanism of source of heritable variations. This was explained by **Hugo de Vries** a dutch botanist. According to him, heritable variations arise when there is a change in genes of the **germplasm** (protoplasm of germcell). He called it **mutation**.

	ON YOUR TIPS	
Creation of variation promotes survival because variant individuals that can with stand or cape with prevailing environment will survive better and will increase in number through differential reproduction		

Origin of Life on Earth (Chemical Evolution of Life)

Life originated on earth through chemosynthesis or formation and coming together of biochemicals. It is called naturalistic theory or theory of chemical origin of life. The theory was given by Russian scientist Oparin (1924) and British turned Indian scientist J.B.S. Haldane (1929).

(i) At the time of formation of earth lighter elements present on the surface were in their atomic state, viz, hydrogen, carbon, nitrogen and oxygen.

(ii) With the slight lowering of surface temperature of earth, the lighter elements interacted and formed water (H_2O), methane (CH_4), ammonia (NH_3), molecular hydrogen (H_2) and carbon dioxide (CO_2). They formed a reducing hot atmosphere of earth. It was exposed to ultraviolet radiations, cosmic rays, lightning and hot lava from volcanoes. Methane, ammonia, hydrogen and other molecules interacted and formed sugars, amino acids, alcohols, fatty acids, nucleotides and other biochemicals. With further interactions and polymerisation, complex organic molecules were formed. Their aggregation formed coacervates or colloidal complexes that developed covering membrane and nucleic acids to produce protocells or primitive cells.



Experimental Proof : Stanley Lloyd Miller and Harold C. Urey (1953) assembled an apparatus to provide conditions similar to those of early earth. They took a mixture of ammonia, methane and hydrogen (2 : 2 : 1) and water, and exposed it to electric sparks, heating and cooling to resemble lightning and provide temperature from 800°C to just below 100°C. After one week, 15% of carbon from methane had been converted into organic compounds of sugars, organic acids, amino acids, purines and pyrimidines. The first primitive organism would arise from further chemical synthesis.

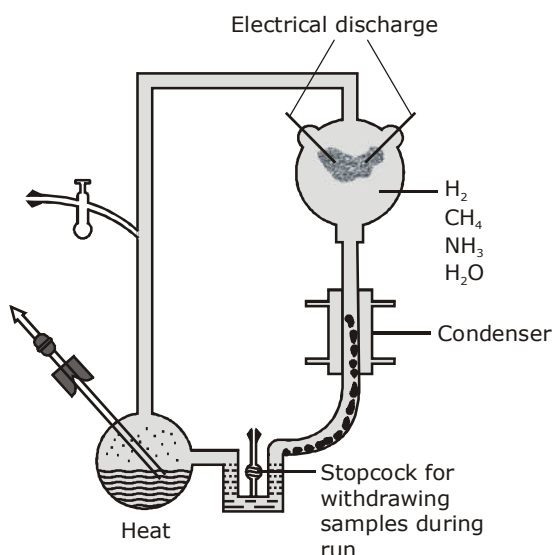


Fig.6

VARIATIONS

Variations are the structural, functional or behavioral changes from the normal characters developed in living organisms. There is an inbuilt tendency to variation during reproduction. Both because of errors in DNA copying as a result of sexual reproduction.

Variations provide raw materials for evolution. These may be inheritable or non inheritable, only inheritable variation participate in evolution.

Type of variation :- On the basis of nature of cells where variations occur variations are of two types.

- (i) Somatogenic variations or Acquired traits (ii) Germinal (Blastogenic) variations.

S.No.	Somatogenic variation	Germinal variations (Blastogenic variations)
1	They occur only in somatic (nongerminal) cells of an individual.	These occur in germinal cells of reproductive organs of an individual
2	These are acquired during the life span of an individual.	These occur at the time of formation of gametes in reproductive organs.
3	These are result of enviromental factors like changes in light, temperature, food availability etc.	These are developed either due to mutation or recombination of genes.
4	DNA of cells is not changed so it is non-inheritable	These are inheritable variations. So they are transmitted from one generation to another e.g.- Polydactyly in man.

An Illustration :- Consider the following example.

1. A group of twelve **red beetles** living in bushes with **green leaves**.
2. Beetles in the population can generate variations because these are reproducing sexually.
3. Crow can eat the beetles. The more beetles the crow eat, the fewer beetles are left for reproduction.

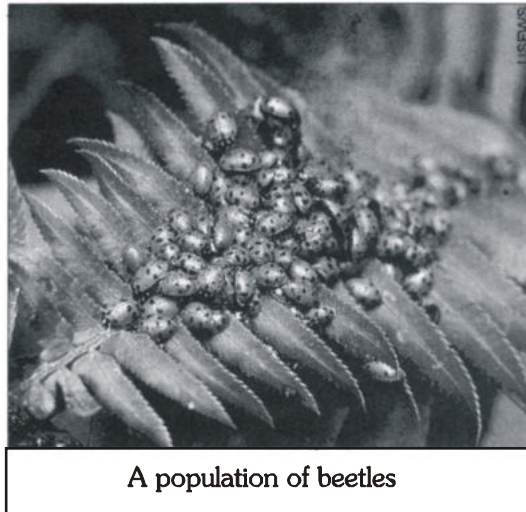


Fig.7

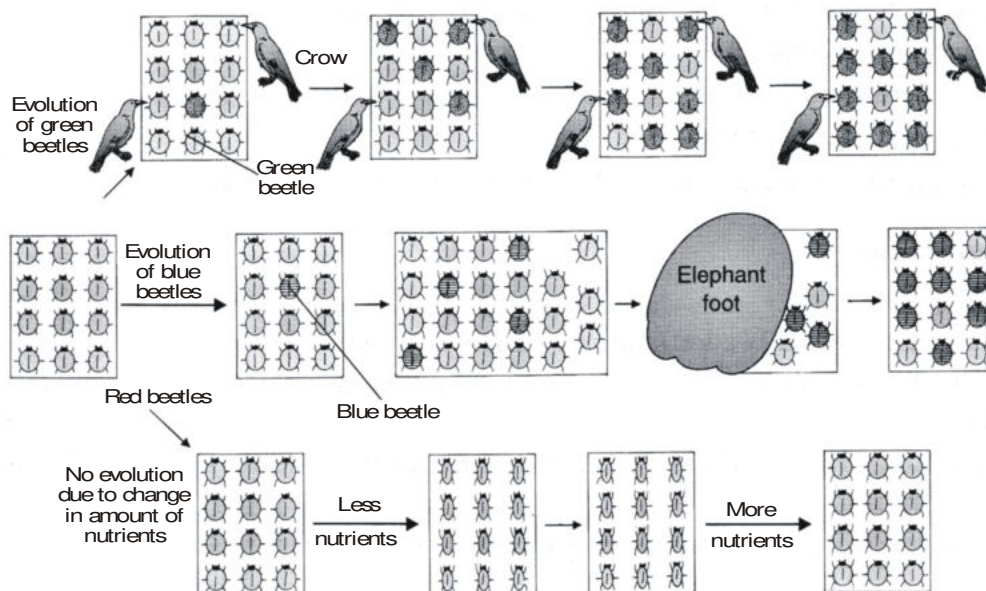


Fig.8 Variation in a population inherited and otherwise

Now consider the following situations :-

1st Situation	2nd Situation	3rd Situation
<ul style="list-style-type: none"> A green colour variation arises during reproduction. One beetle. This green beetle can pass the green colour to its progeny. Crows cannot see green beetles on the green leaves of the bushes so cannot eat them. <p>Observation : More population as compared to red beetles.</p> <p>Conclusion:</p> <ul style="list-style-type: none"> Variations have survival advantage Rare variation came as a common characteristic in the population. In other words, frequency of certain gene traits (genes control the traits) changed over generations. This is the idea of evolution. The number of red beetles decreases as the number of crows increases (Natural selection is directing the evolution). 	<ul style="list-style-type: none"> A blue colour variation arises during reproduction. This blue beetle can pass the blue to its progeny Crows can see blue as well red beetles on the green leaves of bushes so can eat them Most of the beetles are killed by elephant foot. Beetles which survived are mostly blue. This is by chance. <p>Observation: Population of beetles grows slowly and blue beetles are more in number.</p> <p>Conclusion: Variations do not have survival advantage.</p> <ul style="list-style-type: none"> Frequency of certain traits/ genes can be changed by accidents in small populations Both above changes provide diversity without any adaptations. 	<p>Condition 1:</p> <ul style="list-style-type: none"> Appearance of plant disease in the bushes. Amount of plant (leaf) material for the beetles decreases. Beetles are poorly nourished. <p>Observation 1:</p> <ul style="list-style-type: none"> Average weight of beetles decreases. <p>Condition 2:</p> <ul style="list-style-type: none"> Disappearance of plant disease in the bushes. Amount of plant (leaf) material for the beetles increases. Beetles are properly nourished. <p>Observation 2:</p> <ul style="list-style-type: none"> Size of the saturated beetles increases to normal. <p>Conclusion:</p> <ul style="list-style-type: none"> The change in the weight of beetles is not inherited over generations because it is somatic variation



**ON
YOUR
TIPS**



Inherited characters are passed to next generations like Eye color, hair color, shape of nose, height etc. such characters are called germinal characters.

HERITABLE VARIATION

The reason why organisms resemble their parents lie in the precise copying of their genes. Which carry hereditary characters from one generation to the next. On the other hand no two off springs have exactly the same genes. This is because offspring of sexually reproducing organisms receive varying combination of genetic material from both parents such variation result from mutations (errors in DNA copying). Variations also result from **genetic recombination** during sexual reproduction.



**ON
YOUR
TIPS**



Non inherited characters are some characters which we develop in our life time like strong muscles, pierced ear, tattoos on body, hair cut patterns etc, these characters are not passed to next generation and these are called somatic characters

Genetic drift :

The random changes in the gene frequency occurring by chance alone. The effect of genetic drift is very small in large population and large in small populations.

A Little further 2.4



Why the experiences of an individual during its life time cannot be passed on to progeny and cannot direct evolution?

Explanation

Because they do not cause any change in DNA of germ cells.

SPECIES AND SPECIATION

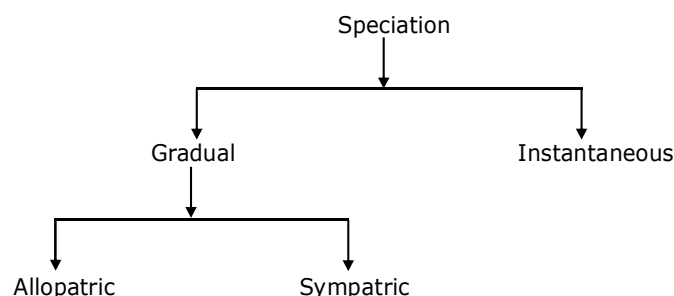
Biological species concept : A species is a sexually interbreeding group of individuals separated from other species by the absence of genetic exchange. Members of species are capable of breeding with one another and produce living, fertile off spring but are unable to breed with members of other species normally.

	ON YOUR TIPS	
In case of genetic drifts genes of individuals are passed on to the next generation. Irrespective of whether they can adapt to the environment or not.		

Gene pool : *Sum of all the genes of all the members of a species.*

Speciation occurs when the gene pool of a population is some how reproductively isolated from other sister population of the parent species and gene flow no longer occurs between them. Then a population splits into independent species. Which become reproductively isolated from each other.

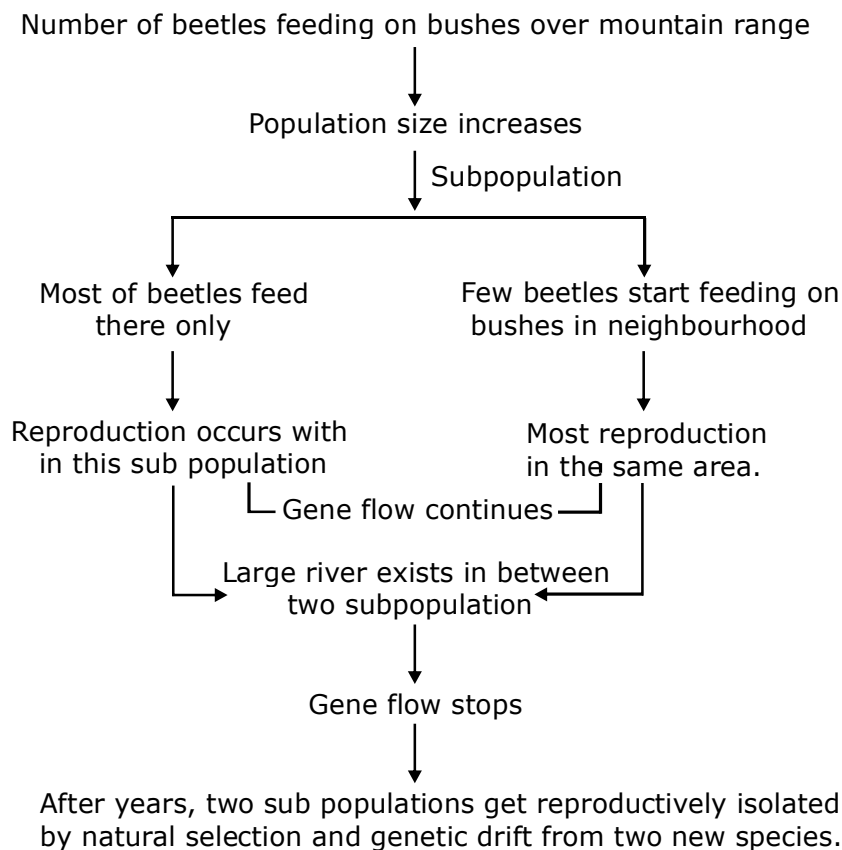
On basis of period taken in speciation there are two types of mechanism of speciation.

**SPECIATION**

The process of formation of one or more new species from an existing species is called speciation.

Let us try to understand this concept by taking the example of beetles.



**ABOVE EXAMPLE OF SPECIATION SHOWS**

- ◆ Large population of beetles occur on a mountain range.
- ◆ Few beetles started feeding in neighborhood.
- ◆ Gene flow continued in two places.
- ◆ They may get isolated at larger distance because of existence of river.
- ◆ Gene flow decreases and finally stops.
- ◆ Two sub populations change with time because of genetic drifts and natural selection.
- ◆ Later they became reproductively isolated.
- ◆ Two new species came up.
- ◆ This can occur as a result of change in chromosome number.
- ◆ Micro evolution is very important this mean that the changes may be small but significant.

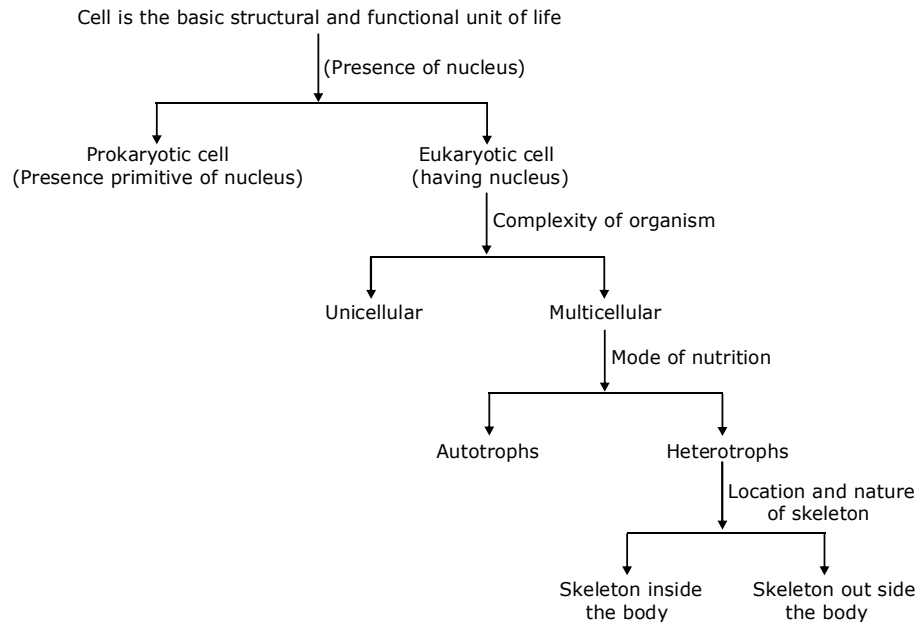
Speciation due to inbreeding, genetic drift and natural selection will be applicable to all sexually reproducing animals geographical isolation does not play any role in the speciation of a *sexually reproducing animals* and self pollinating plants.

EVOLUTION AND CLASSIFICATION

Classification : Classification is the system of arrangement of organism in certain groups or subgroups on the basis of hierarchies of certain characteristics.

The characteristics are the details of appearance from structure, function and behaviour **Phylogenetic taxonomy** is branch of classification on the basis of evolutionary relationship on the basis of common ancestry.



Flow chart of basic characters shared by most of the organisms

A Little further 2.5

What is phylogenetic taxonomy?

Explanation

Taxonomy is term for the branch of classification on the basis of evolutionary relationship on the basis of common ancestry.

TRACING EVOLUTIONARY RELATIONSHIP

Studies on similarities in structure of different organisms suggests that present forms have evolved through a process of slow and gradual change called evolution. They include the following :

- Homologous organs :** Homologous organs are those structures which are different in appearance and perform different functions but have similar basic structure and developmental origin. This relationship is called homology.

FORELIMB IN VERTEBRATES

Seal	Bird	Bat	Horse	Man
Appearance	Flippers	Wings	Patagia	Elongated
Thumb opposability	Swimming flying	Support, flying	Running	Grasping function

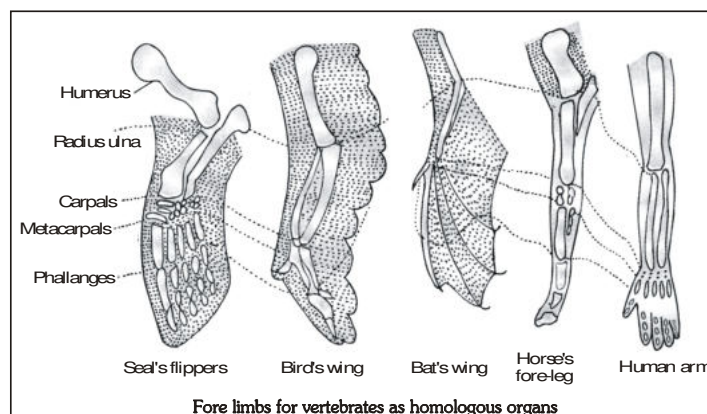


Fig.9



2. **Analogous :** Those organs which have different origin and structural plan but appear similar and perform similar functions are called analogous organs. While this relationship is called convergent evolution or analogy.

eg : Wing of an insect and a bird, Hand of man & Trunk of elephant.

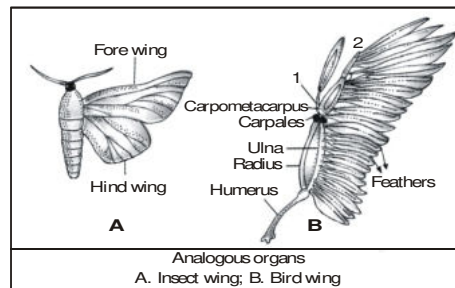


Fig.10

Analogy in these organs is due to similar adaptations to perform similar functions rather than their common ancestry.

3. **Vestigial organs :** Those organs which no longer have a function are called vestigial organs. These organs have reduced structurally as well as functionally. It appears that these organs were once well developed and functional in ancestors and later on due to their less use they became reduced.

eg : Vermiform appendix, ear muscles, third eyelid in man are reduced and function less.

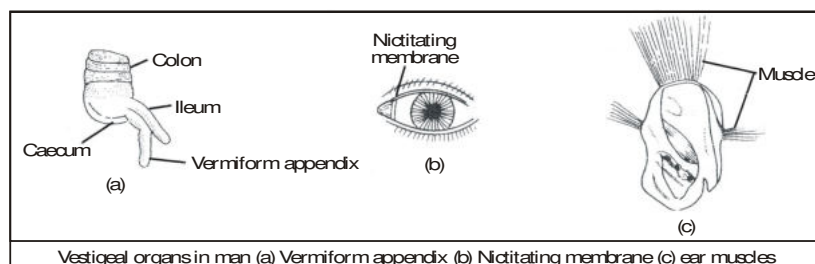


Fig.11

Common ancestry and inter-relationship :

Various organisms are inter connected their resemblance suggest a common ancestry.

Eg : Heart of Fish → Only two chambers

Heart of Amphibia → Three chambers

Heart of Reptilia → Three chambers and half

Heart of Bird and mammals → Four chambered

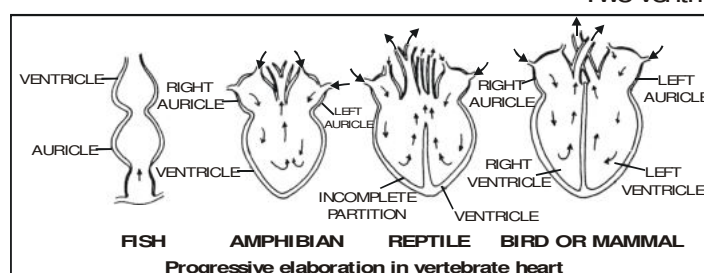
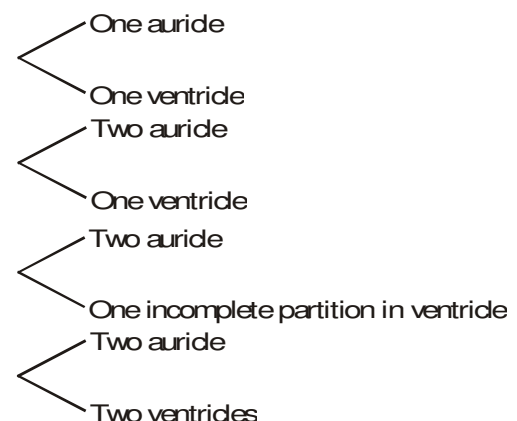


Fig.12

Connecting links : Some living organism have characteristics of two groups. They are known as connecting links.

Eg : Lung fish - show connection between fishes and amphibians.

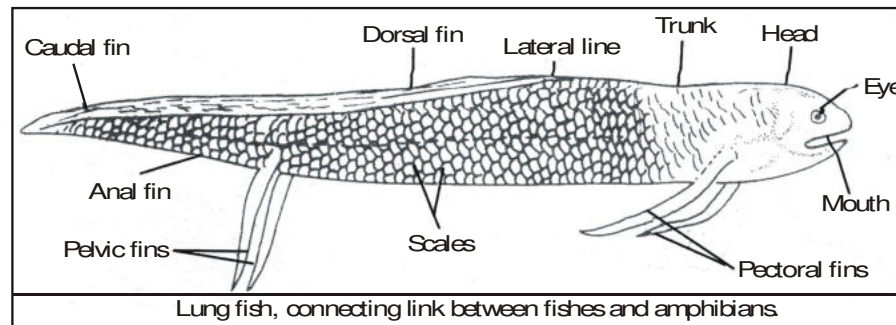


Fig.13

Various connecting links

(i)	Virus	→	Between living and non living
(ii)	Euglena	→	Between plants and animals
(iii)	Proterospongia	→	Between protozoa and porifera
(iv)	Neopilina	→	Between annelida and mollusca
(v)	Peripatus	→	Between annelida and arthropoda
(vi)	Archaeopteryx	→	Between reptiles and birds
(vii)	Balanoglossus	→	Between non chordates and chordates
(viii)	Chimera	→	Between cartilaginous fish and bony fish
(ix)	Lung fish	→	Between fishes and amphibia
(x)	Platypus	→	Between reptiles and mammals
(xi)	Echidina	→	Between reptiles and mammals

Jurassic period is known as golden age of reptiles.

Dinosaur of dromaeosaur family had feather on body and fore limb.

Huxley called birds as glorified reptiles.

Carnivorous dinosaur called velociraptor had a wish bone like birds.

Evidences from embryology :

A comparative study of the stages of embryonic development of animals reveals that in their early stages they were very similar. These embryonic stages reflect thus ancestry. The embryological stages of an organism give us an idea about the stages of its evolution. For example when we study the human embryo, we find that at a certain stage it has gills. This suggests that fish is one of the earliest ancestors in the evolution of mammals including human beings.

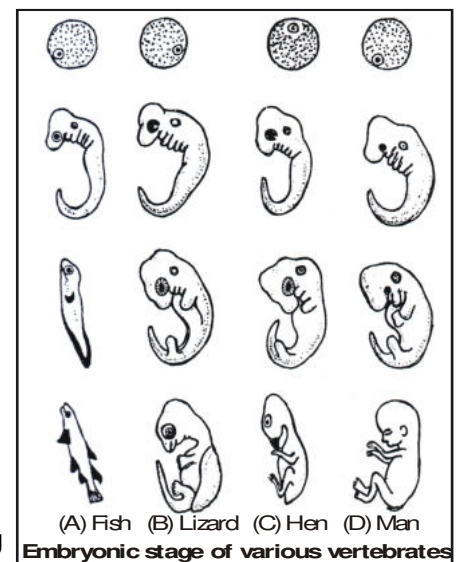


Fig.14

EVIDENCES FROM PALAEOONTOLOGY

- Fossils :** Fossil is an organic relic of a long dead life form.

Or

Fossils are the petrified remains and for impressions of the hard parts of the extinct organism preserved in the sedimentary rock or other media.



Palaeontology : Study of fossils is known as palaeontology.

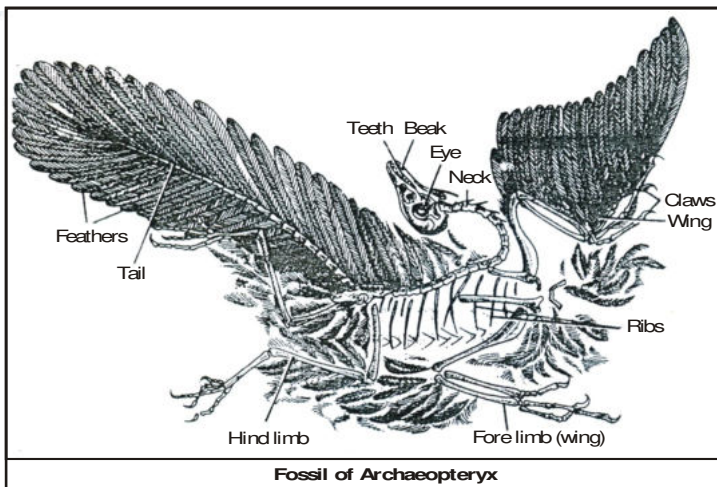


Fig.15

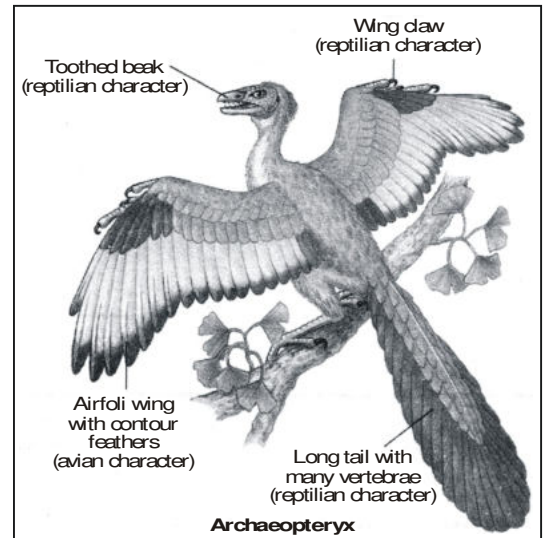
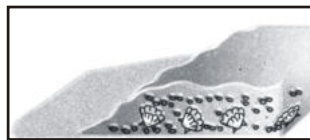


Fig.16

How do fossils form layer by layer ?

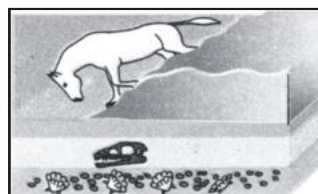


Let us start 100 million years ago. Some invertebrates on the seabed die, and are buried in the sand. More sand accumulates, and sandstone forms under pressure.

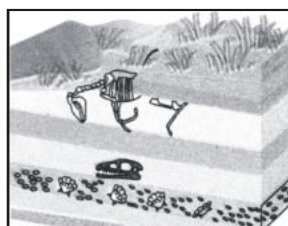
Millions of years later, dinosaurs living in the area die, and their bodies, too, are buried in mud. This mud is also compressed into rock, above the rock containing the earlier invertebrate fossils.



Again millions of years later, the bodies of horse-like creatures dying in the area are fossilized in rocks above these earlier rocks.



Much later, erosion by, sun, water flow, wears away some of the rock and exposes the horselike fossils. As we dig deeper, we will find older and older fossils.



Living fossils : The animals which underwent little change during long geological periods.



IMPORTANT LIVING FOSSILS

1. Peripatus, Limulus (Arthropoda)
2. Nautilus, Neopilina (Mollusca)
3. Lingula (Brachiopoda)
4. Latimeria (Coelacanth fish)
5. Sphenodon (Reptilia)

Determination of the age of fossil : There are three ways of determining age of the fossils.

1. **Relative method :** If we dig into the earth and starts finding fossils it is reasonable to suppose that the fossils we find closer to the surface are more recent than the fossils we find in deeper layer.
2. **Using Radioactive Elements :** The age of a fossil is determined with the help of certain radioactive elements such as uranium present in the rock.
3. **Carbon dating :** Carbon dioxide of air contains a small proportion of radioactive carbon (C^{14}).

CO_2 is used during photosynthesis and there is equal proportion of C^{14} among carbon atoms of all organisms.

The radioactivity of C^{14} is lost at a precise rate half life of C^{14} is about 5,600 years.

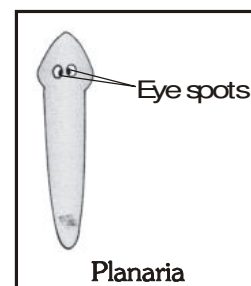
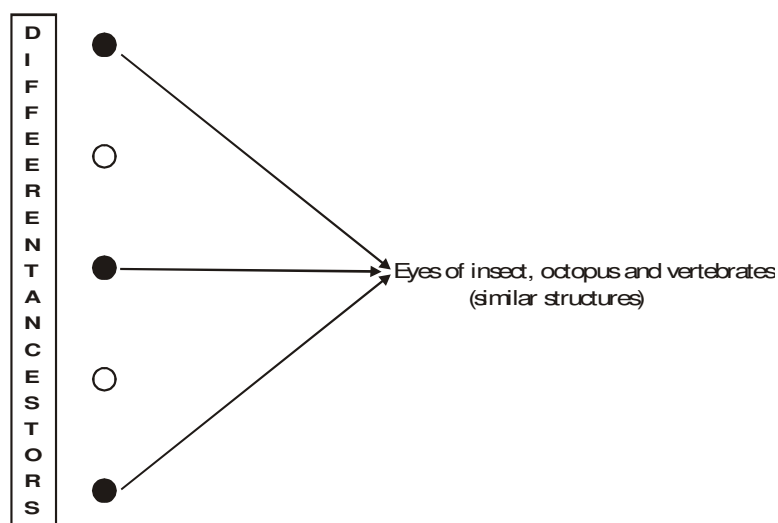
If a fossil shows radioactivity one fourth of that found in the living organisms the organisms died about 11,200 years ago. (Two half lives.)

Evolution by stages

Evolutionary changes are fundamental characteristics

of living organisms such changes may be convergent. It means that the similar looking structures may have different ancestral designs. This can be explained by example of eye.

Eye : Eyes of insects, octopus and vertebrates have similar looks but different structures and must have separate evolutionary origin or different ancestral designs. Rudimentary eye can be useful to some extent.

**Fig.17****Fig.18 Examples of convergent evolution**

Feathers : The function of feathers was insulation in cold weather later this feature might have proved to be useful for the purpose of flight.



Dinosaurs is example depicting presence of feathers in them but these were not used for flying later birds seem to have adaptation of flying using feathers. This shows close relationship of birds to reptiles and proves that characters appearing as an variation can be useful later to perform different functions.

Cabbage : Humans have developed different types of vegetables from the wild cabbage by artificial selection.

S.No. Vegetable evolved Edible part

1. Cabbage Selection for fleshy terminal buds and short distance between the leaves.
2. Brussel's sprouts Selection for fleshy lateral buds.
3. Kohl rabi Selection for fleshy stem.
4. Kale Selection for large sized leaves so it is a leafy vegetable.
5. Broccoli Selection for leafy sized and arrested flower development.
6. Cauliflower Selection for fleshy sterile flower.

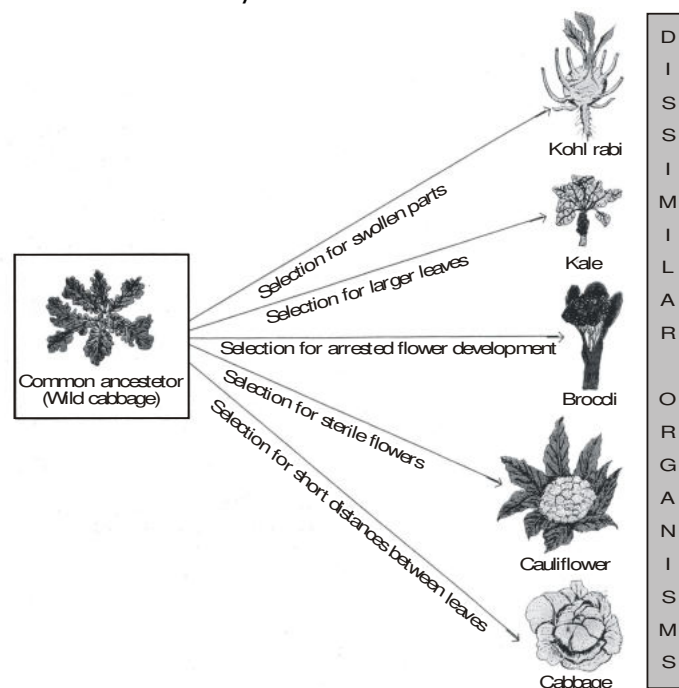


Fig.19 Evolution of wild cabbage [Divergent evolution]

MOLECULAR PHYLOGENY

Ancestors of different organism including humans can be traced by studying the change in their DNA. A change in DNA means a change in its protein sequences. The ancestry or phylogeny determined by comparative study of DNA sequences is called molecular phylogeny.

Studies in molecular phylogeny help in the classification of organisms.

Haeckel propounded '**The theory of recapitulation or 'Biogenetic law'**'. Which states that an individual organism in its development (ontogeny) tends to repeat the stages passed through by its ancestors (phylogeny means ontogeny repeats phylogeny).

EVOLUTION SHOULD NOT BE EQUATED WITH PROGRESS

Though organic evolution involves descent with modification in which there is a progressive trend of emergence of more or more complex body designs from earlier similar body designs by gradual changes but evolution should not be equated with progress because of following reasons.

1. In evolution older species are not eliminated during formation of new species and most of older and simple species still survive.

eg : Earliest organisms like bacteria are found even in many hospitable habitats like hot springs, deep-sea, thermal vents, Antarctic ice. etc.



2. The evolved species are not always better than the parental species evolution depends upon natural selection and genetic drift which is together result in population which is reproductively isolated from the parental species.

HUMAN EVOLUTION

Evolutionary history of man has been built from the palaeontology (fossil studies) and molecular biology (especially DNA changes).

For example :- It is not true that human beings have evolved from chimpanzees. Rather both human beings and chimpanzees have common ancestors a long time ago. That common ancestors is likely to have been neither human or chimpanzee. The two resultant species have probably evolved in their separate ways to give rise to the current forms.

Anthropology : the scientific study of tracing of human evolution is called anthropology. Scientists involved in studying human evolution are called **anthropologists**.

Studies have revealed that human evolution started in Africa and earliest human type was Australopithecus Africans. African ape man fossil was discovered by **Prof. Raymond Dart** fossil of skull of 5-6 years old baby from old Pliocene rock of Tuang region (S.Africa). He name it Tuang baby. It had many ape like characters but had a bipedal locomotion like man. The cradle of human evolution is East Africa where genetic foot prints of earliest members of human species **Homo sapiens** can be traced. A couple of hundred thousand years ago some of own ancestors left across the planet from Africa.

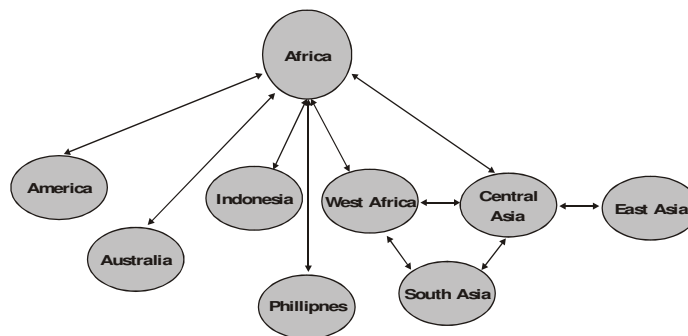


Fig.20 Human evolution

The first human types, evolved into modern man *Homo sapiens* through a number of intermediate human types.

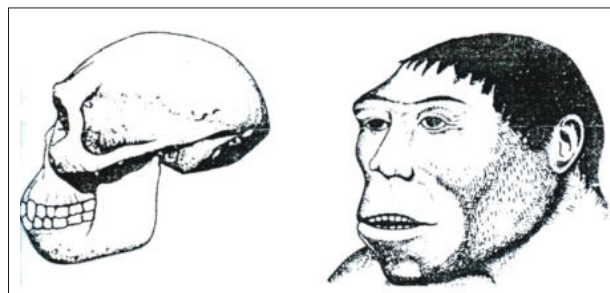


Fig.21 Homo erectus erectus → Java man

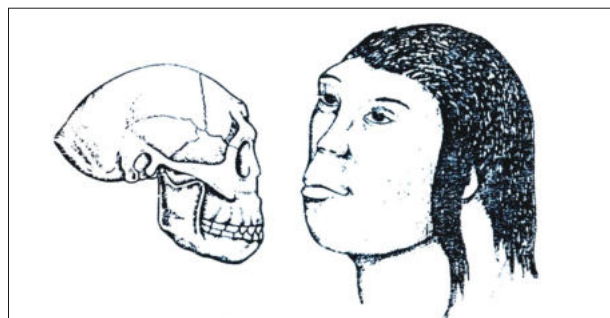


Fig.22 Homo erectus pekinesis → Peking man



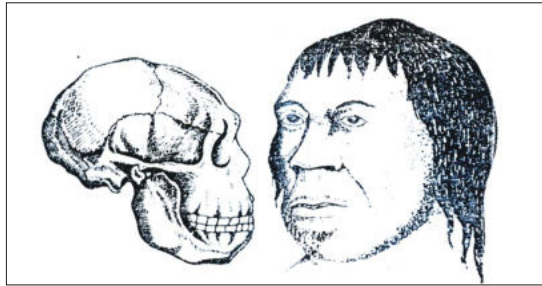


Fig.23 Homo sapiens neanderthalensis → Neanderthal man

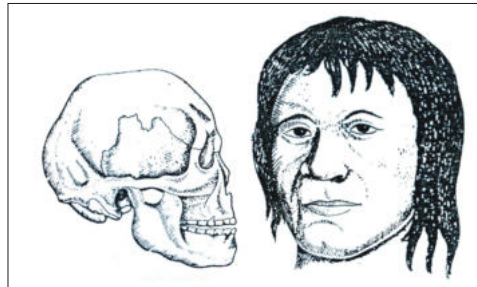


Fig.24 Homo sapiens fossils → Cro-magnon man

In the course of their evolution these migrant human types went forward and backwards and moved in and out of south Africa. Modern man evolved from Cro-Magnon man about 25000 years ago and spread all over the world about 10,000 years.

Modern man is divided into four ethnic groups :

Negroid : African Pygmies and bushman

Caucasian : Italian English

Eastern : Chinese Japanese Eskimos

Mangolid : These ethnic group differ from one another in their skin colouration lips and hair pattern but all of these belong to same species because these are not reproductively isolated from one another. All human races have same chromosomes number and similar grass morphology of chromosomes.

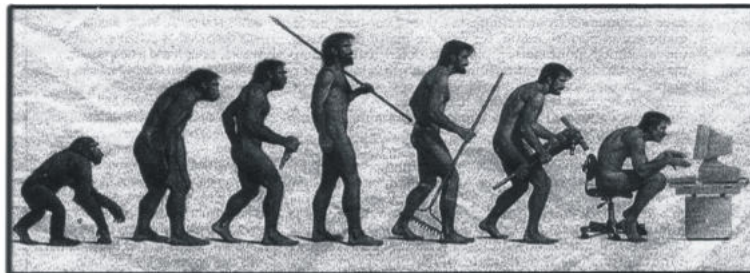


Fig.25 Human evolution

	ON YOUR TIPS	
Anthropology is a branch of science which deal with the study of tracing human evolution is studied.		

Man of future :

Homo sapiens futuralis.

(A prediction by American anthropologist **Dr. Sapiro.**)



N.C.E.R.T TEXT BOOK SOLUTION

- Q.1** If a trait 'N' exists in 10% of a population of an asexually reproducing species and a trait B exists in 60% of the same population, which trait is likely to have arisen earlier?
- Ans.** Trait B is likely to have arisen earlier than trait A, because in asexual reproduction there is lesser chance of creation of variations. New traits are developed due to small inaccuracies produced during DNA copying. These new traits will be in very small proportion of population as compared to already existing traits. Therefore, trait B, which exists in 60% of population must have arisen earlier than the trait A that occurs in 10% of the population.
- Q.2** How does the creation of variations in a species promote survival?
- Ans.** Variations in a species are caused due to error in DNA copying during reproduction. All the variations do not have survival value, only some of them can be beneficial in certain environmental conditions. These are called pre-adaptations. These variations help the individuals of a species to survive in the harsh environmental conditions. These useful variations are selected by nature and are the cause of evolution. The individuals with useful variations then increase in numbers through differential reproduction in the populations. For example, in heat waves, most of the bacteria will die but a few which have preadaptation or variations to tolerate heat will survive and reproduce.
- Q.3** How do Mendel's experiments show that traits may be dominant or recessive?
- Ans.** Mendel crossed two varieties of garden pea plant having contrasting visible characters. He considered one pair of contrasting characters, for example, height (tall and dwarf). The cross between the two, i.e., pure tall plant with pure dwarf plant resulted in production of only tall plants in F_1 generation. When F_1 plants were self-pollinated, Mendel observed both tall and dwarf plants in F_2 generation in a proportionately 3:1 ratio. The trait of dwarfness which was not expressed in F_1 generation, is called a recessive trait. The trait of tallness which expresses itself in the presence of its contrasting character is termed as dominant trait.
- Q.4** How do Mendel's experiments show that traits are inherited independently?
- Ans.** Independent inheritance of traits were proved by dihybrid crosses. In dihybrid cross, Mendel considered two pairs of contrasting characters. In the F_1 generation, both the dominant traits appeared. Self breeding of F_1 yielded four types of individuals in F_2 generation and the ratio was 9 : 3 : 3 : 1. For example: When a tall plant with round seeds (TTRR) is crossed with short plants having wrinkled seeds (ttrr). The plants of F_1 generation were all tall with rounded seeds (TtRr). It indicates that the characteristics of tallness and roundness of seeds were dominant. Self breeding of F_1 plants, yielded 9 tall round seeded, 3 tall wrinkled seeded, 3 short round seeded and 1 short wrinkled seeded plants. Tall wrinkled seeded and short round seeded plants are new combination which can develop if the traits are inherited independently. If the two traits are taken individually, F_2 ratio would be same as for monohybrid crosses (3 : 1), i.e., 12 tall, 4 short, 12 rounded seeds, 4 wrinkled seeds.
- Q.5** A man with blood group A marries a woman with blood group O and their daughter has blood group O. Is this information enough to tell you which of the traits - blood group A or O - is dominant? Why or why not?
- Ans.** No, the information is not enough to tell us which trait of blood group A (I^A) or blood group O (I^O) is dominant because each individual carries two alleles of a gene and recessive trait appears only when both the alleles are similar. There may be two possibilities:
- Blood group A is dominant and blood group O is recessive: Daughter can have blood group 'O' only when both the recessive alleles occur together as in mother ($I^O I^O$) and father has one allele of A and other of 'O' blood group ($I^A I^O$).
 - Blood group 'O' is dominant and blood group 'A' is recessive: In this situation, father should carry both alleles of A ($I^A I^A$) while the mother may be homozygous ($I^O I^O$) or heterozygous ($I^O I^A$). The daughter will have one dominant allele of O ($I^O I^A$).
- As both the possibilities can occur, the given information is unable to tell whether allele for blood group A or O is dominant.



Q.6 How is the sex of the child determined in human beings?

Ans. The sex of a child in human beings is determined by the type of gametes contributed by male during fertilisation. Human males (44 + XY) form two types of sperms, androsperms (22 + Y) and gynospersms (22 + X). Both are formed in equal number. It is a chance whether an androsperm or gynosperm fuses with the egg. If the male gamete with X chromosome fertilises the ovum (X), the sex of the child will be female (XX). However, if male gamete having Y chromosome fertilises the ovum (X), the sex of the child will be male (XY).

Q.7 What are the different ways in which individuals with a particular trait may increase in a population?

Ans. There are various ways in which individuals with a particular trait may increase in number. For example,

(a) Survival value (Natural selection): The trait which is selected by nature has survival value over the others. Through differential reproduction, it increases in population. For example, green colour beetles increased in number as they were not easily located by crows in the green bushes because of their colour.

(b) Genetic Drift: Accident may cause decline in a particular population. The survivor with certain other combinations of traits will increase in number in population. The traits may not give any extra benefit to population.

(c) Abundance of food: Availability of food for the organisms also determines their number.

Q.8 Why are traits acquired during the lifetime of an individual not inherited?

Ans. Acquired traits are not inherited because they are acquired during the lifetime of individuals. These traits do not bring any change in the DNA or germ cell of the individual. These characters induce changes in the non-reproductive tissues (somatic cells) only and not in the germ cells. The alterations (variations) in DNA is passed through germ cells to the next generations. For example, in his experiment Weismann (1892) cut the tails of mice for 21 generations but a tail still developed in the 22nd generation.

Q.9 Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics?

Ans. A small number of surviving tigers is a cause of worry because a small population is always at a risk of extinction due to the following reasons:

(i) The possibility of lesser recombinations and variations which are essential for maintaining vitality and vigour of the species.

(ii) Decreased adaptability towards the environmental changes

(iii) Increased threat to survival due to habitat destruction and poaching

(iv) Excessive inbreeding that may cause inbreeding depression

Q.10 What factors could lead to the rise of a new species?

Ans. The factors which could lead to the formation of new species are: (i) accumulation of variations in a population (ii) natural selection (iii) reproductive isolation (iv) genetic drift (v) absence of gene flow.

Q.11 Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?

Ans. No, geographical barriers will not be a major factor in the speciation of self-pollinating plant species because there is no gene flow among members of the species. Self-pollination occurs within a plant and is not affected by any type of isolation. Self-pollinated plants like pea or wheat can accumulate variations due to mutation and other factors and form new species.

Q.12 Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

Ans. Geographical isolation will not be a major factor in speciation because recombination of genes is absent in asexual reproduction. In asexual reproduction, single parent is involved and a physical barrier can separate two different organisms. So, variations arising in them do not get diluted but spread to all subsequent generations. Geographical isolation helps in speciation due to formation of separate gene pool and has no role in speciation of asexually reproducing organisms.



Q.13 Give an example of characteristics being used to determine how close two species are in evolutionary terms.

Ans. The closeness of two species is determined by the presence of some similar characteristics. For example, thorns of *Bougainvillea* plant and tendrils of *Passiflora* plant have same basic structural design (modified branches) but perform different functions (homologous organs). They have evolved from a common ancestor having fundamental structural design but have developed into thorns and tendrils subsequently and perform different functions.

Q.14 Can the wing of a butterfly and the wing of a bat be considered homologous organs? Why or why not?

Ans. No, wings of a butterfly and wings of a bat cannot be considered as homologous organs because both of them are fundamentally different in their origin and structure. The wings of a butterfly are integumentary outgrowths with hollow tubes whereas wings of a bat are modified forelimbs covered with skin. The organs which have a different origin and structure but similar in function are called analogous organs.

Q.15 What are fossils? What do they tell us about the process of evolution?

Ans. Fossils are the remains or impressions of dead animals and plants that existed earlier. They are often termed as written documents of evolution because they directly indicate the presence of types of flora and fauna in different geological ages. Study of fossils indicates the gradual complexity of organisms. Fossils tell us the following about the process of evolution: (i) Fossils provide direct evidence to support organic evolution. (ii) They indicate the evolutionary stages in the life of an organism/organ. (iii) Fossils also help in tracing the evolutionary relationship among different organisms.

Q.16 Why are human beings who look so different from each other in terms of size, colour and looks belong to the same species?

Ans. Human beings belong to the same species despite of differences in size, colour and looks because they share same gene pool and can reproduce among themselves to produce fertile offspring. Differences in size, colour and looks are based on predominance of specific alleles and their interaction with environment.

Q.17 In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzees have a 'better' body design? Why or why not?

Ans. In evolutionary terms, better body design refers to one which is complex, elaborate and gives an extra competitive edge over other organisms. Out of bacteria, spider, fish and chimpanzee, the chimpanzee has a more elaborate body design and organisation. But all the organisms have a specific body design which is selected to survive in their respective habitat. So, in terms of that, all these four organisms have a good body design which suits their surrounding environment and helps them in their survival.

Q.18 A study found that children with light-coloured eyes are likely to have parents with light-coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive? Why or why not?

Ans. No, we cannot say with certainty whether light eye colour is dominant or recessive. However, the probability is that light eye colour is recessive because both children and their parents have light coloured eyes. A recessive character always appears only when an individual contains both the recessive alleles. If the parent has a dominant trait, the children also have that trait in dominance. Had the light eye been a dominant trait, the recessive dark eye colour might have appeared in some of the children due to chance of segregation.

Q.19 How are the two areas of study, evolution and classification, interlinked?

Ans. Classification is the process of grouping the organisms on the basis of some similarities and differences. These similarities can be morphological (external) or anatomical (internal), which will define their evolutionary relationships. Their differences explain different adaptations and divergence from common ancestor. In this way evolution and classification are interlinked.

Q.20 Explain the terms analogous and homologous organs with examples.

Ans. Refer to text.



Q.21 Outline a project which aims to find the dominant coat colour in dogs.

Ans. (i) Survey the dog population in a locality and find out different coat colours in dogs.
(ii) Observe the lineage where coat colour of parent and offspring are same since there is possibility of having same alleles or a gene in these lineage.
(iii) Allow crossing between two such lineage with different coat colours.
(iv) Observe F_1 generation for coat colour. It is probably the dominant coat colour which appears.
(v) Cross the F_1 progeny to get the ratio in F_2 generation.

Q.22 Explain the importance of fossils in deciding evolutionary relationships.

Ans. Fossils are remains and impressions of organisms that lived in remote past. The strata-wise arrangement of fossils will indicate the occurrence of different forms of life at different times. It is found that earlier fossils generally belong to simple organisms and complexity and elaboration of characters increase gradually with evolution. Fossils are direct evidences in support of organic evolution and help in determining evolutionary relationships between organisms. They indicate how one group has evolved from another.

Q.23 What evidence do we have for the origin of life from inanimate matter?

Ans. Miller and Urey supported the origin of life from inanimate matters. They assembled an apparatus which had a spark chamber to produce lightning, a boiling flask and a condenser. They introduced a mixture of CH_4 , NH_3 , H_2 and H_2O (water vapour) into this apparatus. The gaseous mixture was exposed to electric discharge, boiling ($800^\circ C$) and condensation with the temperature kept just below $100^\circ C$. This experiment continued for few days. At the end of a week, 15% of carbon from methane has converted into simple organic compounds of amino acids, sugars, organic acids and nitrogenous bases. The experiment clearly proved that organic compounds (building blocks of life) developed from inanimate matter in the remote past when the hot earth was cooling and they took part in origin of life on earth.

Q.24 Explain how sexual reproduction gives rise to more viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?

Ans. Variations arise during sexual reproduction due to:

- (i) Chances of separation of homologous chromosomes at the time of gametogenesis.
- (ii) Crossing over between the chromosomes
- (iii) Chance of coming together of chromosomes at the time of fertilisation
- (iv) Genetic mutation at the time of DNA replication.

In asexually reproducing organisms, only mutation takes place. Thus, in asexually reproducing organisms, rate of appearance of variations is quite low as compared to sexually reproducing organisms. The variation of sexually reproducing organisms are more viable than variations of asexually reproducing organisms. The reason of variations is reshuffling of genes that do not occur in asexually reproducing organisms. Here most of the changes are harmful and show negative impact on evolution. Due to the abundance and viability of variations, the rate of evolution in sexually reproducing organisms is high.

Q.25 How is the equal genetic contribution of male and female parents ensured in the progeny?

Ans. During sexual reproduction, genetic materials of two parents combine together to form a new individual. Both male and female parents contribute 50% of genetic material each. Thus, the offspring will have half of the information of father and half of the mother. Therefore, both parents contribute equal genetic material to the offspring through formation and fusion of gametes.

Q.26 Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not?

Ans. No, because variations in an individual arise due to many reasons such as natural selection, genetic drift, mutation, etc. They may not be beneficial for the organisms but still they persist in the population. Only the lethal or extremely harmful variations are eliminated, rest of them exist in a population.



EXERCISE – I**NTSE / OLYMPIAD / FOUNDATION PROBLEMS****OBJECTIVE QUESTIONS**

1. Genetics is the branch of science which deals with the study of :-
 (A) cell function (B) cell structure
 (C) heredity and variation (D) relation between plant and environment
2. The term 'genetics' was coined by :-
 (A) William Bateson (B) Gregor Mendel
 (C) Thomas Hunt Morgan (D) W. Johannsen
3. The term 'gene' was introduced by :-
 (A) Mendel (B) Bateson (C) Morgan (D) Johannsen
4. When a gene exists in more than one form, the different forms are termed :-
 (A) alleles (B) heterozygotes
 (C) genotypes (D) complementary genes
5. The contrasting pairs of factors in Mendelian crosses are called :-
 (A) alloloci (B) paramorphs (C) allelomorphs (D) multiple alleles
6. Alleles of a gene are found on :-
 (A) same chromosome (B) any chromosomes
 (C) homologous chromosomes (D) nonhomologous chromosomes
7. Which statement about alleles is not true :-
 (A) There may be several at a locus (B) One may be dominant over another
 (C) They may show incomplete dominance (D) They occupy different loci on the same chromosome
8. An organism which receives identical alleles of a particular gene from both parents is :-
 (A) homozygote (B) hemizygote (C) homothallic (D) heterozygote
9. The genetic complement of an organism is known as :-
 (A) genotype (B) physiotype (C) phenotype (D) morphotype
10. The physical appearance of an individual is known as :-
 (A) heterotype (B) genotype (C) morphotype (D) Phenotype
11. The terms 'genotype' and 'phenotype' were introduced by :-
 (A) Bateson (B) Darwin (C) Johannsen (D) Mendel
12. What was Mendel's most important contribution to the modern understanding of biology :-
 (A) The concept of meiosis
 (B) The concept of chromosome
 (C) The concept that genes are ordered along chromosomes
 (D) The concept that hereditary information comes in discrete units



HEREDITY AND EVOLUTION

13. Gregor Mendel was born in :-
(A) Austria (B) Russia (C) Czechoslovakia (D) United Kingdom
14. Mendelism is related with :-
(A) Heredity in living beings (B) Meiosis during sexual reproduction
(C) Mutations in living organisms (D) None of the above
15. Mendel published the results of his experiments in the year :-
(A) 1568 (B) 1773 (C) 1866 (D) 1921

FILL IN THE BLANKS

- The life arose from nonliving molecules was suggested by
- Experimental evidence in favour of chemical origin of life was provided by and
- The process by which new species arise is called
- The biogenetic law was proposed by
- The fossils of birds show that birds have evolved from reptiles.
- Darwin made an extensive study of the flora and fauna of the..... Islands in South America.
- The origin of species was written by

ANSWER KEY

OBJECTIVE QUESTIONS

1. C 2. A 3. D 4. A 5. C 6. C 7. D
8. A 9. A 10. D 11. C 12. D 13. A 14. A
15. C

FILL IN THE BLANKS

- Anaximander
- A.I. Oparin, J.B.S. Haldane
- Speciation
- Haeckel
- Archaeopteryx
- Galapagoes islands
- Charles Robert Darwin



EXERCISE – II**PRACTICE FOR SUMMATIVE ASSESSMENT****VERY SHORT ANSWER TYPE QUESTION**

1. What is a gene ?
2. Write the scientific term used for 'science of heredity and variation'.
3. Define inheritance.
4. What term did Mendel use for what we now call the genes ?
5. How does the creation of variations in a species promote survival ?
6. Name the plant on which Mendel performed his experiments.
7. Define Variation.
8. What are the carriers of factors or genes ?
9. Name two human traits which show variation.
10. Write down five inherited 'characters' or traits.

SHORT ANSWER TYPE QUESTIONS

1. Why did Mendel choose pea plants for his experiment ?
2. What is Mendel's genetics ?
3. If a trait A exists in 10% of a population of an asexually reproducing species and a trait B exists in 60% of the same population, which trait is likely to have arisen earlier ?
4. A Mendelian experiment consists in breeding tall pea plants bearing violet flowers with short pea plants bearing white flowers. The progeny all bore violet flowers, but almost half of them are short. This suggests that the genetic makeup of the tall parent can be depicted as :-
 (i) TTWW (ii) TTww (iii) TtWW (iv) TtWw
5. Explain the mechanism of sex determination in human beings.

LONG ANSWER TYPE QUESTIONS

1. Explain diagrammatically a Mendel's dihybrid cross.
2. Briefly explain contributions of Mendel in Genetics.



FOR SCHOOL EXAM.

EXERCISE-III

SECTION-A

• Fill in the blanks

1. The ratio phenotypic for the monohybrid cross is _____.
2. Characters that are expressed in any conditions are called _____ and characters that are expressed only in homozygous conditions are called _____.
3. _____ is physical and chemical expression of a character.
4. Every organism have _____ sets of all genes, one inherited from _____.
5. The formation of new species is known as _____ basis of heredity.
6. Genes are _____.
7. _____ are preserved traces of living organism.
8. Classification of a species is infact a relation of their _____.

SECTION-B

• Multiple choice question with one correct answers

1. Genetics is the study of
(A) Inheritance (B) Cell structure (C) Only plants (D) Only animals
2. If two parents have the genotypes $AA \times aa$, the probability of having an aa genotype in the F_1 generation is
(A) 25 percent (B) 50 percent (C) 75 percent (D) None of these
3. Sex-linked disorders such as colour blindness and hemophilia are
(A) caused by gene on the X-chromosome (B) caused by gene on the autosome
(C) caused by gene on the Y-chromosome (D) Expressed only in men
4. Your arm is homologous with
(A) a seal flipper (B) an octopus tentacle (C) a bird wing (D) both (A) & (C)
5. Which option represents test cross
(A) $TT \times TT$ (B) $Tt \times tt$ (C) Both (A) & (B) (D) None

SECTION-C

• Assertion & Reason

Instructions: In the following questions as Assertion (A) is given followed by a Reason (R). Mark your responses from the following options.

- (A) Both Assertion and Reason are true and Reason is the correct explanation of 'Assertion'
 (B) Both Assertion and Reason are true and Reason is not the correct explanation of 'Assertion'
 (C) Assertion is true but Reason is false
 (D) Assertion is false but Reason is true

1. **Assertion:** Chemical basis of heredity is DNA.
Reason: Cellular DNA is the information source for making protein in the cell.
2. **Assertion:** Genes are functional segment DNA.
Reason: Genes are responsible for the expression of an enzyme.
3. **Assertion:** Variation are formed during reproduction.
Reason: Errors in DNA copying and sexual reproduction do not causes evolution.
4. **Assertion:** Speciation is the phenomenon by which new spp. comes into existence.
Reason: Genetic drift does not lead to speciation.
5. **Assertion:** The birds have pneumatic or hollow bones with air sacs



Reason: These adaptations help them during flight

SECTION-D

• **Match the following (one to one)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. Only One entries of column-I may have the matching with the same entries of column-II and one entry of column-II Only one matching with entries of column-I

1. Column I

- (A) Minor differences in progeny
- (B) Gregor Mendel
- (C) Heridity
- (D) Change in frequency of gene
- (E) Charles Darwin

Column II

- (P) Theory of evolution
- (Q) Transmission of characters from parents to child
- (R) Genetic drift
- (S) Due to inaccuracies in copying of DNA
- (T) Law of inheritance

2. Column I

- (A) Monohybrid cross
- (B) Sex-chromosomes
- (C) Artificial selection
- (D) Analogous organ
- (E) New species formed

Column II

- (P) Wings of Bat and Bird
- (Q) Not neccesary better then old
- (R) One pair (xx/XY)
- (S) production of different varities of cabbage from wild cabbage
- (T) 3 : 1

EXERCISE-IV

SECTION-A

• **Multiple choice question with one correct answers**

1. Mendel formulated some laws which are known as
 - (A) Law of germplasm
 - (B) Law of origin of species
 - (C) Law of speciation
 - (D) Law of inheritance
2. Term 'GENE' was given by
 - (A) Mendel
 - (B) Morgan
 - (C) Bateson
 - (D) Boveri
3. Mendel choose pea plants because
 - (A) They were cheap
 - (B) They were having seven pairs of contrasting characters
 - (C) They were attractive
 - (D) Of great economic importance
4. The resemblance of individual to their progenitors is due to
 - (A) Heredity
 - (B) Genetics
 - (C) Evolution
 - (D) None of these
5. Linkage is contradicton to _____ law of Mendel
 - (A) Mutation
 - (B) Independent assortment
 - (C) Dominance
 - (D) Cross-ing over
6. Law of purity of gametes is also known as
 - (A) Law of inheritance
 - (B) Law of variation
 - (C) Law of independent assortment
 - (D) Law of segregation
7. Mendel formulated the law of purity of gametes on the basis of
 - (A) Dihybrid cross
 - (B) Monohybrid cross
 - (C) Back cross
 - (D) Test cross
8. A white flowered mirabilis plants rr was crossed with red coloured RR, if 120 plants are produced in F₂



generation. The result would be

- (A) 90 uniformly red and 30 white (B) 90 Non-uniformly coloured and 30 white
(C) 60 Non-uniformly coloured and 60 white (D) All coloured and 40 white

SECTION-B

• **Multiple choice question with one or more than one correct answers**

- Mendel law's of inheritance include
(A) Law of Dominance (B) Law of segregation
(C) Law of independent assortment (D) Law of variation
- Human originated in Africa and migrated to
(A) Philippines (B) India
(C) Indonesia (D) Bering land bridge
- Which of the following is originated from wild cabbage?
(A) Broccoli (B) Kale (C) Kohlrabi (D) Brassica

SECTION-C

• **Comprehension**

Passage-1

Genetics is the branch of biology that deals with heredity and variations and heredity is the ability of a living organism to pass on its characters to its offspring. The transmission of dissimilar character is called variation. In asexual reproduction only very minor differences between progeny are seen, due to small inaccuracies in DNA copying where as great diversity is generated in case of sexual reproduction variations affects the survival of an organism. Depending on the nature of variation, different individual would have different kinds of advantages.

- Branch of biology deals with heredity & variations –
(A) Genetics (B) Cell biology (C) Zoology (D) Palaeontology
- Transmission of dissimilar character.
(A) Heredity (B) progeny (C) variation (D) None of these
- Great diversity is generated in case of
(A) Asexual reproduction (B) sexual reproduction (C) both (A) & (B) (D) None of these

Passage-2

Gregor Johann Mendel (1822-1884) known as the father of Genetics. Mendel was educated in a monastery and went on to study science and mathematics at the university of Vienna. After the failure in examination for a teaching certificate, he came back to his monastery and started his experiments on garden pea. Mendel used a number of contrasting visible characters of garden pea – round/wrinkled seeds, tall/short plant, white/violet flowers and so on. After his studies on garden pea he gave the law of inheritance.

Mendel gave three laws – law of Dominance, law of segregation, law of independent assortment.

- Mendel is known as _____.
- On which plant Mendel worked?
- How many laws did Mendel give?
- In which examination did Mendel fail?

SECTION-D

• **Match the following (one to many)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. One or more than one entries of column-I may have the matching with the some entries of column-II and one entry of column-II may have one or more than one matching with entries of



column-I

1. Column I

- (A) Phenotypic ratio
 (B) Genotypic ratio
 (C) Monohybrid cross/ratio
 (D) Dihybrid cross ratio

Column II

- (P) 1 : 2 : 1
 (Q) 3 : 1
 (R) 9 : 3 : 3 : 1
 (S) Tt × tt

Answers

Exercise-III**Section-A**

- | | |
|---------------|------------------------------|
| 1. 3 : 1 | 2. dominant, recessive |
| 3. Phenotypes | 4. two, each parent |
| 5. Speciation | 6. Physical |
| 7. Fossils | 8. Evolutionary relationship |

Section-B

- | | | | | |
|--------|--------|--------|--------|--------|
| 1. (A) | 2. (D) | 3. (A) | 4. (D) | 5. (B) |
|--------|--------|--------|--------|--------|

Section-C

- | | | | | |
|--------|--------|--------|--------|--------|
| 1. (A) | 2. (B) | 3. (C) | 4. (C) | 5. (A) |
|--------|--------|--------|--------|--------|

Section-D

- | | |
|--------------------------------------|--------------------------------------|
| 1. (A-S), (B-T), (C-Q), (D-R), (E-P) | 2. (A-T), (B-R), (C-S), (D-P), (E-Q) |
|--------------------------------------|--------------------------------------|

Exercise-IV**Section-A**

- | | | | | |
|--------|--------|--------|--------|--------|
| 1. (D) | 2. (C) | 3. (B) | 4. (A) | 5. (B) |
| 6. (D) | 7. (B) | 8. (A) | | |

Section-B

- | | | |
|------------|------------|------------|
| 1. (A,B,C) | 2. (A,C,D) | 3. (A,B,C) |
|------------|------------|------------|

Section-C**Passage-1**

- | | | |
|--------|--------|--------|
| 1. (A) | 2. (C) | 3. (B) |
|--------|--------|--------|

Section-D

- | |
|--|
| 1. (A)-(QR), (B)-(P), (C)-(P,Q,S), (D)-(R) |
|--|



EXERCISE – V

FOR OLYMPIAD

- Mendel conducted his hybridisation experiment with :-
(A) Chick pea (B) Pigeon pea (C) Garden pea (D) Wild pea
- Mendel studied seven contrasting characters for his breeding experiment with *Pisum sativum*, which of the following character did he not use :-
(A) Pod colour (B) Pod shape (C) Leaf shape (D) Plant height
- The main reason of Mendel's success in discovering the principles of inheritance was :-
(A) He considered each character separately (B) He was lucky not to encounter linkage problem
(C) The plant was pure breeding (D) All the above
- Mendel was lucky in the choice of the material of his experiments, among the following, which contributed, to his success ?
(A) He observed distinct inherited traits (B) He qualitatively analysed his data
(C) He liked pea plants (D) He considered only one character at one time
- The year 1900 AD is highly significant for genetics due to :-
(A) Principle of linkage (B) Chromosome theory of heredity
(C) Rediscovery of Mendelism (D) Discovery of genes
- Genotype means :-
(A) Genetic composition of the individual (B) Genetic composition of the germ cell
(C) Genetic composition of plastids (D) Genetic composition of an organ
- The physical manifestation of an organism's genes is its :-
(A) Environment (B) Phenotype (C) Genetic code (D) Genotype
- An organism with two identical alleles of a gene in a cell is called :-
(A) Homozygous (B) Dominant (C) Heterozygous (D) Hybrid
- When an individual is having both the alleles of contrasting characters it is said to be :-
(A) Heterozygous (B) Dioecious (C) Monoecious (D) Linked genes
- When an allele fails to express itself in F_1 generation in the presence of other allele, the former is said to be :-
(A) Recessive (B) Codominant (C) Complementary (D) Epistatic
- Alleles are :-
(A) Homologous chromosome (B) Chromosome that have crossed over
(C) Alternate forms of gene (D) Linked genes
- Mendel's laws apply only when :-
(A) F_1 in monohybrid cross shows two types of individuals
(B) The characters are linked
(C) Parents are pure breeding
(D) First pair of contrasting character is dependent upon other pairs
- Which of Mendel's procedures differed from those of his predecessor and contributed most of his success ?
(A) He observed many characteristics of each trait (B) He observed distinct inherited traits
(C) He quantitatively analysed his data (D) He kept breeding records
- If a plant is heterozygous for tallness, the F_2 generation has both tall and dwarf plants. This proves the principle of :-
(A) dominance (B) segregation (C) independent assortment (D) incomplete dominance
- Mendel crossed a pure white flowered recessive pea plant with a dominant pure red flowered plant. The first generation of hybrids from the cross should show :-
(A) 50% white flowers and 50% red flowers (B) all red flowered plants



- (C) 75% red flowered and 25% white flowered plants (D) all white flowered plants
16. If a couple has three daughters, what are the chances that the fourth child will be a son ?
 (A) 100% (B) 75% (C) 50% (D) 0%
17. If a heterozygous tall plant is crossed with a homozygous dwarf plant, the proportion of dwarf progeny will :-
 (A) 50% (B) 75% (C) 100% (D) 25%
18. The crossing of a homozygous tall plant with a dwarf would yield F_2 plants in the ratio of :-
 (A) two tall and two dwarf
 (B) one homozygous tall, one homozygous dwarf and two heterozygous tall
 (C) all homozygous dwarf
 (D) all homozygous tall
19. When a true breeding tall plant is crossed with a true breeding short plant and the F_1 produced is self pollinated to produce F_2 ratio of true breeding tall and true breeding short plant in F_2 will be :-
 (A) 1 : 2 (B) 1 : 1 (C) 2 : 1 (D) 1 : 3
20. Blue eye colour in human is recessive to brown eye colour. The expected children of a marriage between blue-eyed woman and brown-eyed male who had a blue-eyed mother are likely to be :-
 (A) all blue-eyed (B) three blue-eyed and one brown-eyed
 (C) all brown-eyed (D) one blue-eyed and one brown-eyed
21. The genotype of a dominant parent is determined by crossing it with the recessive parent. This cross is called :-
 (A) back cross (B) test cross (C) long cross (D) out cross
22. The results of a test cross reveal that all the offspring resemble the parent being tested. This parent must be :-
 (A) heterozygous (B) homozygous (C) recessive (D) haploid
23. Chromosome theory of heredity was postulated by :-
 (A) Charles Darwin (B) Gregor Mendel (C) Sutton and Boveri (D) Har Gobind Khorana
24. Which chromosome set is found in male grass-hopper ?
 (A) XY (B) X (C) YY (D) XX
25. Allosomes are :-
 (A) bead like structures (B) on chromosomes (C) sex chromosomes (D) rounded bodies
26. *Escherichia coli* is widely used in genetics research because it is :-
 (A) easy to procure (B) easily manipulated
 (C) easy to handle (D) easy to culture in laboratory
27. Mutation is :-
 (A) a change that is inherited
 (B) a change, which affects the parents only but never, inherited
 (C) a change, which affects the offspring of F_2 generation only
 (D) a factor responsible for plant growth
28. Recessive mutation are expressed normally in :-
 (A) has to express always since it is a mutation (B) heterozygous condition
 (C) neither in homozygous nor in heterozygous condition (D) homozygous condition
29. The reason why some mutations, which are harmful, do not eliminated from gene pool is that :-
 (A) they are recessive and carried by heterozygous individuals
 (B) they are dominant and show up more frequently
 (C) genetic drift occur because of a small population
 (D) they have future survival value



HEREDITY AND EVOLUTION

30. Mutations are usually induced by :-
(A) gamma rays (B) alpha rays (C) beta rays (D) visible light
31. The plant that was made popular by "De Vries mutation theory" :-
(A) *Triticum vulgare* (B) *Oenothera lamarckiana* (C) *Pisum sativum* (D)
Primula vulgaris
32. Gene mutation is caused :-
(A) due to reproduction (B) due to changes in the sequence of nitrogen bases
(C) due to linkage (D) due to changes in the sequence of genes in DNA
33. Sex chromosomes may be found in :-
(A) unisexual plant (B) unisexual flower (C) monocarpic plant (D) intersexual plant
34. Which one of the following is a sex-linked characteristic ?
(A) White eye in *Drosophila* (B) Duffy blood group in human beings
(C) AB blood group in human beings (D) Vestigial wing
35. Human offspring would be female, if 23rd pair of chromosome in zygote is :-
(A) YY (B) XY (C) XX (D) XYY
36. "Barr body" is derived from :-
(A) autosomes in males (B) autosomes in females (C) X-chromosome in female
(D) X-chromosome in males
37. Down's syndrome is due to :-
(A) nondisjunction of chromosomes (B) crossing over between genes
(C) linkage of genes (D) sex linked inheritance
38. The DNA is the genetic material was proved conclusively by :-
(A) J D Watson (B) Hershey and Chase (C) Alfred Griffith (D) Boveri and Sutton
39. Nobel Prize for "one gene one enzyme theory" was given to :-
(A) Beadle and Tatum (B) Schleiden and Schwann
(C) Watson and Crick (D) H Harris
40. Retrovirus has the following as its genetic material :-
(A) single stranded DNA (B) double stranded duplex DNA
(C) DNA-RNA hybrid (D) RNA
41. Of the following, which sequence is present in Rous Sarcoma Virus ?
(A) DNA ® RNA ® proteins (B) DNA ® DNA ® proteins
(C) RNA ® DNA ® proteins (D) RNA ® DNA ® RNA ® proteins
42. The term genome is used for :-
(A) diploid set of chromosomes (B) polyploid set of chromosomes
(C) triploid set of chromosomes (D) haploid set of chromosomes
43. The first successfully cloned mammal that gained world-wide publicity was :-
(A) Molly, a sheep (B) Polly, a sheep (C) Chance ; a bull (D) Dolly, a sheep
44. The transgenic animals are those that have :-
(A) foreign DNA in some of its cells (B) foreign DNA in all its cells
(C) foreign RNA in all its cells (D) both (A) and (C)
45. The first hormone artificially produced by culturing bacteria is :-
(A) Insulin (B) Thyroxine (C) Testosterone (D) Adrenalin



Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	C	D	D	C	A	B	A	A	A	C	C	C	B	B	C	A	B	B	D
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	B	B	C	B	C	D	A	D	A	A	B	B	A	A	C	C	A	B	A	D
Ques.	41	42	43	44	45															
Ans.	D	D	D	B	A															





OUR ENVIRONMENT

INTRODUCTION

The physical and biological world we-live in is called our **environment**. It has the following three important parts :

1. Living organisms
 2. Physical surroundings
 3. Meteorological factors (or climatic factors).
- The living organisms which constitute environment are plants; animals, human beings and micro-organisms.
 - The physical surroundings, which make up the environment are land, water bodies and air.
 - The meteorological factor or climatic factors, which form a part of our environment, are sunlight, temperature, rainfall, humidity,

In this chapter we are going to learn about interaction of various factors of the environment and effect of human activities affecting various biogeochemical cycles or environment.

	ON YOUR TIPS	
Ecology is the study of inter relationships of organisms between the biotic and abiotic components of their environment. The 'Ecology' term was coined by Ernst Haeckel (1868).		

ENVIRONMENTAL PROBLEMS

Effect of human activity is an important factor which causes difference in the environment of different places. Through overuse, misuse and mismanagement of natural resources to fulfil his needs, man has done great damage to the environment himself. Various environment problems have arisen as a result of pollution, increasing population and coming up of advanced science and technology.

There is crowding, very less number of trees, large number of factories, which emit black smoke and large number of motor vehicles which emit poisonous gases. Moreover, due to large population there is lot of garbage, which is thrown indiscriminately on roads and other common places. These uncontrolled human activities not only pollute the city environment like soil, air and water but also harm the living organisms that are so essential for our survival. All these activities lead to ecological imbalance.

POLLUTION AND POLLUTANTS

With the increase in human population and advancement in technology waste materials have multiplied in quantity as well as quality. Contamination of environment with these waste material is called pollution. Not only the wastes but certain useful materials like fertilizers may also contaminate the environment. Thus, pollution may be defined as a change in the physical, chemical or biological aspects of environment which make it harmful for living organisms. Materials or agents which cause pollution of the environment are termed as pollutants e.g., smoke from vehicles, industries, sewage, various radioactive substances.

Pollutants are categorized into two types.

(a) Biodegradable pollutants (b) Non-biodegradable pollutants

Biodegradable pollutants can be quickly degraded by natural means i.e., by the action of various micro-organisms e.g. , sewage, paper, wool, bones and wood.

Non-biodegradable pollutants are either not degraded or degraded very slowly. They are not easily broken down e.g., DDT, plastics, radioactive wastes, silver foil, aluminium cans, glass and plastics. These pollutants may accumulate in large concentration as they pass through various food chains. Pollution is of five main types-Air, Water, Land, Radioactive and Noise.



ADDITION OF WASTES TO THE ENVIRONMENT

ACTIVITY 3.1

To prove that some domestic waste materials change their form and structure over time while others remain unchanged over long periods.



Procedure

1. Collect all kinds of waste materials from your home. These waste materials will mainly include:
 - kitchen wastes like vegetable and fruit peels, spoilt food, used tea leaves, milk packets and empty cartons
 - paper
 - empty medicine strips and bottles
 - old torn clothes
 - plastic bottles
 - broken foot wear
 - polythenes.
2. Dig a pit at home or in the school.
3. Put all waste material in a pit.
4. Cover the pit with soil and keep it wet.
5. Observe after 15 days.

Conclusion

Few materials **change** their shape and structure over period of time and are called as **biodegradable materials** while others remain **unchanged** are non-biodegradable. Few biodegradable materials change fast while others take longer time.

From above experiment, it is clear that some of the junk is readily degradable by .the activity of micro-organisms in nature and materials are recycled but some are not easily degraded like polythene, plastics etc.

	ON YOUR TIPS	
On the basis of size, ecosystem may be classified as : (1) Small ecosystem (flowerpot, water in a dish). (2) Large ecosystem (forest, desert, ocean).		

BIODEGRADABLE AND NON-BIODEGRADABLE MATERIALS

Different waste materials produced by various activities of man can be broadly classified into two categories:

1. Biodegradable wastes
2. Non-biodegradable wastes.

BIODEGRADABLE WASTES

Biodegradable wastes materials are those waste materials which can be broken down into simpler, non-poisonous substances by the action of micro-organisms. As we know various enzymes are required to digest/hydrolyse or break food into simpler forms. These enzymes are specific in action and act only on a specific material. That is why various man made materials like plastic cannot be degraded by action of bacteria or saprophytes. They can be changed only by physical processes like heat and pressure. Some examples of biodegradable wastes are : cattle dung, paper, wool, wood, bones, leather, plant products such as wheat, maize, etc. Many industries also produce biodegradable wastes. All biodegradable wastes should be treated properly before discharging them into soil or water. Any industrial unit, which dumps untreated wastes into soil or water, should be severely punished.



Recycling of Biodegradable Waste Materials Sometimes biodegradable wastes are recycled. In the recycling process, the nutrients withdrawn from various nutrient pools are returned back. Use of cattle dung for the manufacture of gobar gas and use of waste vegetable matter for preparing compost are two examples of recycling of biodegradable wastes.

Recycling of waste materials helps in maintaining ecological balance because during this process various nutrients present in the waste are returned back to the natural pools from where they were initially withdrawn. For example, plants draw various nutrients from soil for their growth. When the plants die, they change into waste, which can be converted into compost by the action of bacteria. When compost is added to the soil as manure the various nutrients are returned back to it. Thus, recycling of waste materials helps in maintaining ecological balance. If the various nutrients are continuously drawn from the soil but are not returned back, it may create an imbalance in nature.

NON-BIODEGRADABLE WASTES

The waste materials, which cannot be broken down into simpler substances easily in nature, are known as non-biodegradable wastes. Aluminium cans, silver foil, iron nails, plastics, glass, DDT and radioactive wastes are some examples of non-biodegradable wastes. These nonbiodegradable wastes are major pollutants of the environment.

Radioactive waste materials are one of the non-biodegradable wastes, which can pollute the earth to dangerous levels of toxicity. These wastes are produced in nuclear reactors, laboratories and hospitals, which use radioactive substances. These radioactive wastes release high-energy particles, which are extremely harmful to all living forms, both animals (including man) and plants. Pollution caused by nuclear wastes assumes a universal dimension because the particles emitted by radioactive wastes spread far and wide in a short period and hence affect the populations, which are quite away from the source of pollution. Thus, pollution due to nuclear wastes is not a problem of a particular country but is a problem of the whole world.

To conclude, we can say that recycling of waste materials helps in maintaining the ecological balance in the following ways :

1. Recycling of biodegradable wastes such as biomass helps in returning the various nutrients to the soil.
2. Recycling of non-biodegradable wastes reduces the problem of pollution because disposal of these wastes causes pollution.
3. As a result of recycling of waste materials new resources are not used. For example recycling of paper reduces the cutting of trees for the manufacture of paper.
4. Recycling reduces the volume of wastes.
5. Recycling is better than incineration as it prevents pollution.

A Little further 3.1
"All the flesh of a carnivore is grass." Justify the statement
Explanation
Carnivores depend upon herbivores for their food. And herbivores eat plants to obtain energy. Herbivores build up their tissues with the help of chemical energy obtained from plants and carnivores build up their tissues with the help of chemical energy obtained from herbivores (by eating them). This justifies the statement. "All the flesh of a carnivore is grass."

ECOSYSTEM AND ITS COMPONENTS

No organism or a species lives alone, always there are associations influencing each other and organising themselves into communities. The organisms of any community besides interacting among themselves, always have functional relationship with the environment. This structural and functional system of communities and their environment is called an **ecosystem**.

Two main components of ecosystem are: Biotic (living) and Abiotic (Non-living).



BIOTIC COMPONENTS includes autotrophs and heterotrophs (consumers and decomposers).
Classification of Living Organisms

Living organisms are mainly classified as producers, consumers and decomposers.

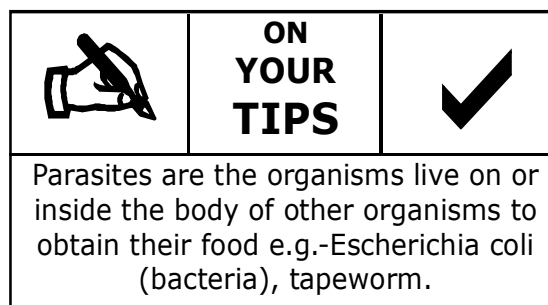
- **Producers** include plants and some blue green algae which can make their own food in the form of organic compounds like sugar and starch by the process of photosynthesis. They are also called autotrophs.

- **Consumers** depend on producers directly or indirectly. **Herbivores** directly eating plants are called **primary consumers** while **carnivores** consuming herbivores are **secondary consumers**.

Both producers and consumers have their life cycles and new generation of population develop while old ones die. If the materials so locked in the body of the organism are not returned to soil and atmosphere, the cycling of materials will stop and earth will be full of dead organisms. There is continuous, breaking up or decomposition of organic materials everywhere in all ecosystems. This role is played by **decomposers**.

- **Decomposers**. Some organisms with a specialized mode of nutrition and life like bacteria, fungi constantly decompose dead organic materials into simple inorganic substances and during the process derive from them their food and energy. These are called **decomposers** or **reducers**. You can understand role of decomposers by not cleaning aquarium.

- **Parasites**. Some of the consumers live on or in other organisms and derive their nourishment from host's body. They are known as **parasites** e.g., Tape worm, leech.



ABIOTIC COMPONENTS include materials and energy. Materials are like water, mineral salts, atmospheric gases etc. and energy is like light, heat, stored energy in chemical bonds etc.

Abiotic part is divided into 3 components:

1. **Inorganic substances** like carbon, nitrogen etc.
2. **Organic compounds** like carbohydrates, proteins, fats etc.
3. **Climate** like temperature, light, pressure etc.

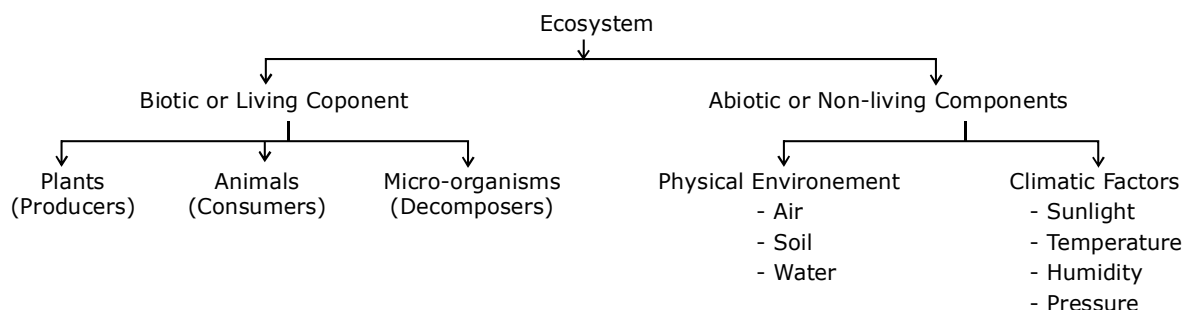


Fig. 3.1 COMPONENTS OF ECOSYSTEM

- The **materials** continuously keep on cycling i.e., entering into the living system and through death and decay returning to soil and atmosphere. This process is called **mineral circulation** or the bio-geochemical cycles.

- While materials keep on cycling, fresh **energy** is continuously trapped from the sun by green plants on one hand and lost in space through respiration by all types of organisms.



TYPES OF ECOSYSTEMS

- **Terrestrial ecosystem** are named after the type of organism and habital conditions, such as grassland ecosystem, crop ecosystem, forest ecosystem and desert ecosystem.
- **Fresh water ecosystems** are usually named upon the size and nature of fresh water body, such as river ecosystem, pond ecosystem, lake ecosystem.
- **Marine ecosystem** is the largest and most uniform aquatic ecosystem.

Some of the ecosystems are man made and are called **artificial ecosystem**. e.g., garden, aquarium etc.

Ecosystem is a functional system which in balanced condition is self-sufficient and self-regulated.

But at the same time, several ecosystems are interrelated and combine to form larger ecosystem. e.g., the tree ecosystem in association with have variety of other trees, smaller plants and animals form forest ecosystem.

A Little further 3.2
Why decomposers are known as deaners of the environment?
Explanation
Due to the presence of decomposers the various nutrient elements which were initially taken by plants from the soil, air and water are returned to the soil, air and water after the death of plants and animals thus decomposer organisms help in recyling the materials

FOOD CHAIN

- The series of organisms fixing energy, eating and being eaten is called a **food chain**.
- Each step of a food chain is called a **trophic level**.
- **First trophic level** always consist of autotrophs which can fix solar energy.
- **Second trophic level** is that of herbivores feeding on autotrophs.
- **Third trophic level** includes primary consumers feeding on herbivores.
- **Fourth trophic level** includes secondary consumers which feed on primary consumers.

Food chain can be traced in any ecosystem e.g.,

Food chain in a grassland

Grass → Grasshopper → Frog → Snake → Vulture.

Food chain in a forest

Plants → Deer → Lion.

Food chain in a pond

Phytoplanktons → Zoo planktons → small fish → big fish.

- The food chain starting from the green plants through herbivores to top carnivore is called **grazing food chain**.
- Food chain starting from the dead organic matter being consumed by detritus feeding micro-organisms which in turn are eaten by some other predators is called **detritus food chain**.

In order to understand how an imbalance is created due to disruption of food chains by man's activities, let us consider the food chain

Grasses → Deers → Lions.



1. In the above food chain, **if all the lions are removed**, the population of deer will increase since there won't be any lions to kill them and keep the population under control. This will lead to high consumption of grasses (producers) and may even eliminate them.
2. **If the deer population is removed** instead of lions, it will lead to decrease of lion population since there will not be any prey. The lions may even resort to other preys such as domestic animals or man to survive.

If the deer and lion operate in other food chains in a food web, then the removal of any of them will lead to disruption of the food web and will cause disturbance in the ecosystem

3. **If the grasses (producers) are removed**, then all life will come to an end. If there is no there will be no herbivores. If there are no herbivores, there will be no carnivores. ultimately all organisms will die.

A Little further 3.3

In comparing the two ecosystems 'A' and 'B' it is obtained that 'A' has only first and second order consumers, while 'B' has third, fourth and fifth order consumers. Which of the two would be more stable ?

Explanation

A' will be more stable because it has lesser number of trophic levels.

FOOD WEB

- The food relations are not always simple chain like but forms complicated network. The netlike trophic interrelationship is called a **food web**.
- In a food web, one organism may be linked with several others in an interlocking food linked into a network.
- In all ecosystems not only the different grazing food chains get interlocked but the detritus chain also get interconnected.
- At each trophic level some energy is used for itself, some passes to the next trophic organisms as food and some is routed to the detritus food chain by way of excretion.

Food chains do not operate in isolation i.e., various food chains are interconnected to each other forming a complex network. For example, food chains in a grassland, a forest, a crop field or a pond form a network with intercrossed and linkages. Grass may be consumed by rabbit which is in turn consumed by hawks. The grass is also consumed by insects which in turn are consumed by frogs. Frogs are consumed by snakes and snakes by hawks.

The network formed by various food chains which are interconnected with each other is called a **food-web**.

A particular organism may occupy position in more than one food chains. For example, in the food web shown above, mice are present in two food chains. These chains are :

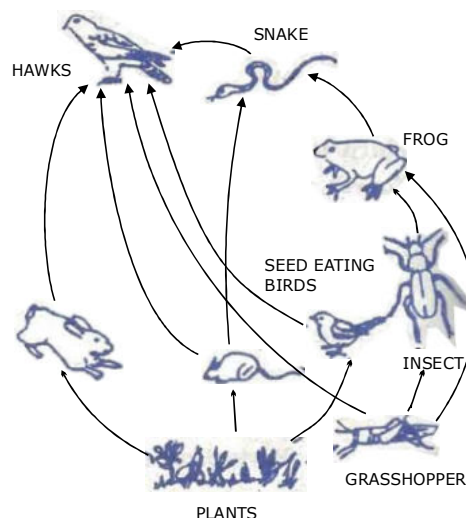


Fig.3.2 A FOOD WEB

Plants → Mice → Snakes → Hawks

Plants → Mice → Hawks

In the first food chain mice are consumed by snakes whereas in the second food chain they are consumed by hawks.

Other food chains operating in this food web are :

Plants → Grasshopper → Frogs → Snakes → Hawks

Plants → Grasshopper → Insects → Frogs → Snakes → Hawks

Plants → Rabbits → Hawks

Plants → Seed eating birds → Hawks.

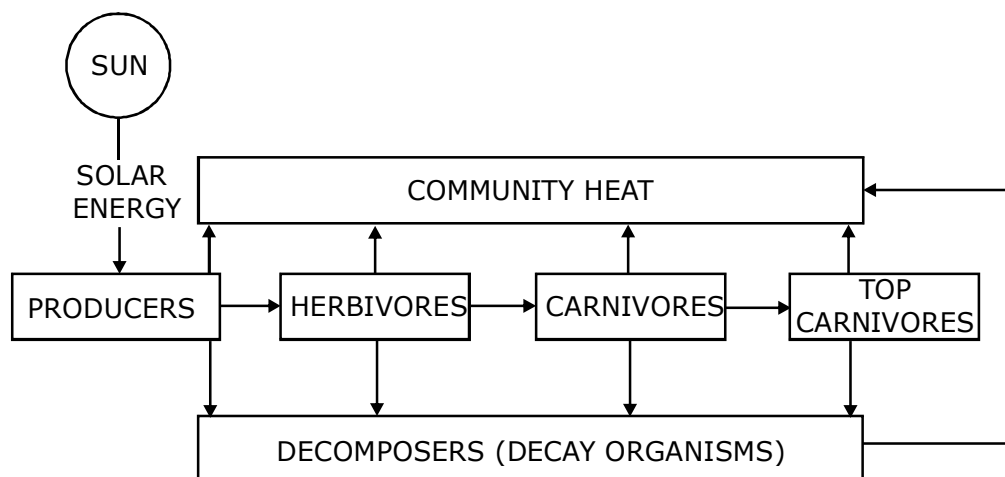
THE FLOW OF ENERGY IN AN ECOSYSTEM

In a food chain, food which provides energy is transferred stepwise from one trophic level to another. Thus, energy is used and conveyed from one trophic level to another. This process is called '**flow of energy**'. It is a one way process and energy once used by the food chain of an ecosystem is lost forever.

The initial level where energy from the environment enters the living components is at the producer level. Green plants trap solar energy from the sun and utilize it for photosynthesis. Plants are able to trap the sun's energy due to the presence of green pigment, **chlorophyll**, present in them. This process converts solar energy into chemical energy which is stored as carbohydrates.

About 1% of the total sun's energy that reaches earth is used up in photosynthesis. The chemical energy stored in plants is used up in their respiration growth (tissue building) and repair. Some of the energy is not utilized and is released into the community environment.

Plants are consumed by herbivores (First order consumers). The chemical energy stored in the plants as carbohydrates is consumed by herbivores as food. A portion of this energy is used for metabolic activities and growth of the herbivores. Some of the energy is not utilized and is released by these animals as heat into the environment.



	ON YOUR TIPS	
Kites and vultures as they feed on dead organisms and act as scavengers (cleansing agents) of the environment).		

The herbivores are consumed by carnivores (Second order consumers) and the same process is repeated as in herbivores and unutilized energy is released into the environment by these animals as heat. The amount of energy which is released as heat into the environment is taken to be lost. It may be noted that a part of the energy at each trophic level is transferred to the decomposers or decay organisms. The decomposers utilize a part of this energy for maintaining their life processes. The unutilized energy is released as heat into the environment.

From above discussion we conclude :

- One percent of solar energy is trapped by green plants and is converted into food energy by the process of photosynthesis.
- Part of the chemical energy in plant tissues is passed from organism to organism as they are successively eaten.
- Ultimately the entire energy trapped by green plants at one time is lost from the ecosystem in several stages.
- 10% energy is passed from one trophic level to another. e.g., when green plants are eaten by herbivores then only 10% of the energy available with plants is passed to them.
- Most of the heat i.e., 80% is lost as heat to the environment and some is used to carry out various metabolic activities like digestion, growth, reproduction etc., and doing work.
- Energy therefore does not move in a free condition, but rather through organic materials from one trophic level to another.
- One important concept of ecological energetics is that energy always flows in one direction in the ecosystem while materials like carbon, nitrogen, hydrogen, oxygen etc. are repeatedly used in the ecosystem cycling from inorganic to organic and back to inorganic forms.

• Since very small amount of energy is passed to the next trophic level, food chains consist of three to four steps. After this, energy left is not sufficient to survive.

• At each trophic level, some energy is transferred to the decomposers. The decomposers utilize a part of this energy for maintaining their life processes.

• There is a loss of energy at each energy transfer in various trophic levels, which is lost to the environment in the form of heat. Therefore, the amount of energy available at each successive level is less than

the previous level.

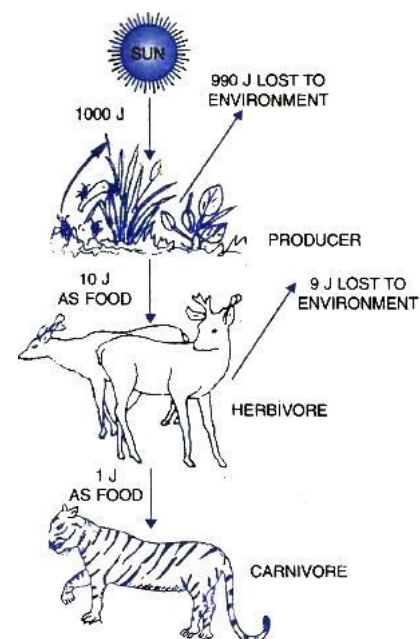


Fig. 3.3

Studies of various food chains show that **the energy available at each successive level is 10% of the previous level.** This is called the **10 per cent law.** In the given illustration, 1000 J of energy is available to the plants from the sun. Plants convert 1 per cent of this energy into chemical energy. Thus, 10 J of energy is stored in plants. This energy is available to herbivores. Herbivores retain 10 per cent of 10 J i.e., 1 J as stored energy and 9 J of energy would be lost to the environment. Thus, only 1 J of energy would be available to carnivore as food.

The flow of energy in the living components of the biosphere is unidirectional.

The energy enters the living components from non-living environment through photosynthesis. The radiant energy of sun converted into chemical energy is never converted back into radiant energy but is dissipated into the atmosphere as heat at every step. In food chain, a large amount of energy remains unutilized and is lost to the environment as heat at each trophic level. The energy lost as heat to the environment cannot be reutilized by plants for photosynthesis.



Energy transfers in the biosphere in food chains obey the laws of thermodynamics.

- **The first law of thermodynamics** says that energy can be converted from one form to another but can never be created or destroyed. In a food chain it is observed that energy is converted from one form to another. It is frequently transformed into heat energy which is unusable and is released into the environment. But the energy itself is not destroyed.
- According to the **second law of thermodynamics** energy transformation is never completely efficient. Whenever energy is transformed from one form to another, there is a decrease in the amount of useful energy; a part of energy is converted into heat. Thus, energy transformation in the biosphere among living organisms obeys the laws of thermodynamics.

Vegetarian food habits can provide more energy :

It can be observed that with successive trophic levels, there is decrease in the amount of energy available. Hence, if we are closer to the producer level, we can get more energy (calories) from the food because at the producer level, the amount of energy available is the highest. Consider the two food chains involving man as given below :

Producers (Plants) \longrightarrow Goat \longrightarrow Man

Producers (Plants) \longrightarrow Man

In the second food chain, man is closer to producer level and hence he gets more energy. On the other hand in the first food chain involving three steps man is away from the producer level and hence gets less energy. As an illustration, let us consider a case in which plants receive 1000 J of energy from the sun. Plants convert 1% of the solar energy into food. Thus, 10 J of energy would be stored in plants as food. Now, if the man is vegetarian then he would get 10 J of energy by eating plants.

Plants $\xrightarrow{10J}$ Man

However, if the man is non-vegetarian he would receive only 1 J of energy by eating meat in a three step food chain

Plants $\xrightarrow{10J}$ Goat $\xrightarrow{1J}$ Man

Here goat receives 10 J of energy and transfers 10% to man. Thus, a non-vegetarian man receives only 1 J of energy. From this we conclude that vegetarian food habits provide more energy than non-vegetarians.

ECOLOGICAL PYRAMIDS

Food chains involving various living organisms in a community can also be represented in a graphical manner by drawing pyramids called ecological pyramids.

An ecological pyramid is a graphical representation of a specific parameter (such as number, biomass or energy) of a food chain.

Ecological pyramids have various levels. The producer level is represented by the base of the pyramid. And as the trophic levels increase the pyramid goes on tapering upwards. The carnivores are on top of the pyramid.

Ecological pyramids can be of various types-pyramid of number, pyramid of biomass, pyramid of energy. Pyramid of number is constructed on the basis of the number of organisms at each level. Pyramid of weight is constructed on the basis of biomass of all the organisms at each trophic level. Pyramid of energy is constituted on the basis of the energy contained in all the organisms at each trophic level.

PYRAMID OF NUMBERS

Pyramid of numbers is constructed on the basis of the number of organisms at each trophic level in the food chain.

In a food chain, the number of animals decreases at successive trophic levels. At the bottom of the pyramid are the green plants which synthesize food through photosynthesis, using sun's energy. Just above the plants are herbivores. The animals at the lowest level of the pyramid are large in number. At the successive higher levels of the pyramid, the number of animals decreases. The top carnivores at the top of the pyramid are very few. For example, in a forest there may be large number of deers but there will be only a few lions.



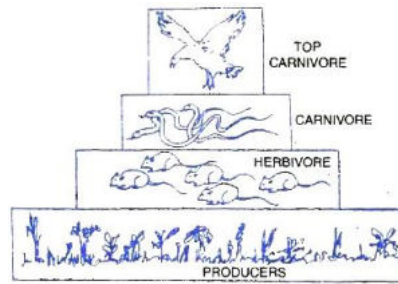


Fig.3.4 PYRAMID OF NUMBERS

PYRAMID OF BIOMASS

Biomass means the amount of living matter. **The pyramid of mass is constructed on the basis of mass of all organisms in each trophic level in the food chain.** The total biomass of the plants is greater than that of the herbivores. The total biomass is greater than that of first order carnivores. **In a food chain only 10 per cent of the biomass is transferred from one trophic level to the next level in the food chain** as illustrated

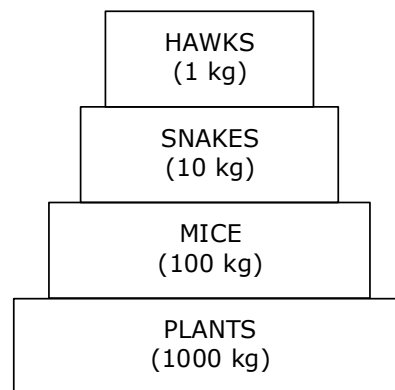


Fig. 3.5 PYRAMID OF BIOMASS

PYRAMID OF ENERGY

The pyramid of energy is constructed on the basis of total energy contained in all the organisms of each trophic level of the food chain. As discussed earlier, the amount of usable energy decreases at each trophic level in a food chain because at each step some energy is lost as heat to environment. Plants have the maximum store of chemical energy. Herbivores have less energy which is only about 10 per cent of the energy stored in plants. **Only 10 per cent of the chemical energy of previous level is retained by the next trophic level.** This is called **10 per cent law**. As an illustration let us assume that 10 J of energy is stored in plants. Herbivores feeding upon them would retain 1 J (10% of 10 J) of energy. Carnivores feeding on herbivores would gain 0.1 J (10% of 1 J) of usable energy. This is illustrated

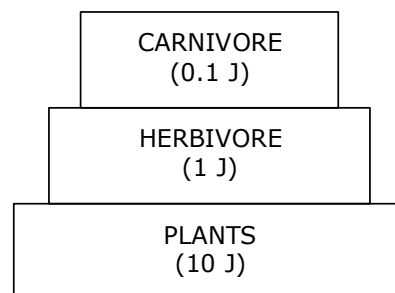


Fig. 3.6 PYRAMID OF ENERGY

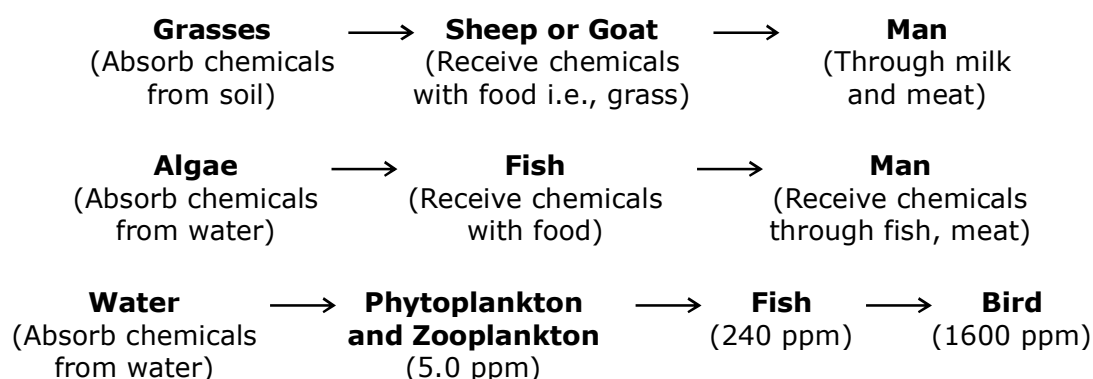
BIOMAGNIFICATION

Biomagnification is another aspect of food chain in which harmful chemicals enter food chains and are passed from one trophic level to another getting concentrated at each level.



ACCUMULATION OF HARMFUL CHEMICALS IN FOOD CHAINS

It is seen that through the food chain some harmful chemicals enter our bodies. We know that pesticides and insecticides are used to protect crops from diseases and pests. These chemicals enter the soil and gradually either enter the water table or get absorbed by plants along with water and mineral salts. Thus, they enter the food chain at the producer level. At each trophic level these harmful chemicals get more and more concentrated and ultimately reach our bodies. It has been shown by studies that humans have higher concentration of these chemicals than organisms lower in the food chain. For example, DDT which is used against mosquitoes is present in the highest concentration in human beings. Thus, we can conclude that an organism which is on the extreme right of the food chain, has the maximum concentration of the harmful chemicals in its body. This phenomenon is known as biomagnification or biological magnification. The following example illustrates the phenomenon of biomagnification.



The process of concentration of harmful chemicals such as pesticides, at each successive step in a food chain is called **biological magnification**.

Man being an omnivorous, eats fish, meat as well as vegetables. Being a powerful and intelligent animal, he is very rarely eaten by any animal. Moreover he disposes his dead ones in such a way that scavengers do generally not consume them. Thus, he is at the top of most food chains. In other words, he is only a consumer. **As a result of pollution, there are greater chances of accumulation of harmful chemicals in his body, which can be very harmful.**

Accumulation of Metallic effluent like mercury and fluorine are very harmful for human health. Mercury can lead to disease namely Minamata and fluorine can lead to knee-knock syndrome i.e., bending of legs. Fluorine may also cause fluorosis.

• Methods to reduce intake of pesticides

- Use of manures rather than fertilizers.
- Minimum use of chemicals like pesticides etc.

Instead biological method should be used to control insects and pests.

- Disease resistant varieties of crops should be developed by using hybridisation technique.
- Domestic and Industrial wastes should not be disposed in lakes and rivers.
- Wash fruits and vegetables before their consumption.

EFFECT OF HUMAN ACTIVITIES ON ENVIRONMENT

Some of the activities of man have disturbed the environment:

1. Deforestation



- For getting wood for fuel and furniture.
- For developing fields for cultivation.
- For developing urban areas.



2. Mining to get various minerals, coal and petroleum.
3. Use of large number of vehicles for transportation.
4. Generation of electricity through
 - Thermal power plants.
 - Hydroelectric power plants.
 - Nuclear power plants.
5. Construction of roads, railway tracks etc.
6. Development of many harmful products such as plastics.
7. Extensive use of pesticides and other chemicals.
8. Use of chlorofluorocarbons.

Various human activities change the environment and affect us. In this chapter we are going to discuss two major environmental problems i.e.

- Ozone layer depletion.
- Waste disposal.

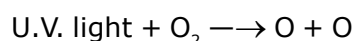
	ON YOUR TIPS	
<p>The use of a lot of clay for making millions of kulhads daily led to the loss of fertile top soil from fields. So, the practice of using kulhads has been discontinued.</p>		

OZONE DEPLETION

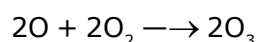
As we know that around 23 km from the surface of the earth there is a thick layer of ozone gas. **It is formed by the action of sun's rays on oxygen.** This thick layer of ozone also called **ozone blanket** is very effective in absorbing ultraviolet radiations given out by the sun. Thus, it protects the earth from the harmful effects of ultraviolet rays. In the year 1980 scientists noticed a 'hole' in the ozone blanket covering the upper surface around Antarctica. This fact is of great concern as harmful ultraviolet rays can now come to the earth through this hole. This will increase the level of uV-rays reaching the earth. An increased level of ultraviolet rays is very harmful as it can cause skin cancer and genetic disorders.

Main cause of depletion of ozone layer is chlorofluorocarbons (CFCs). Another cause of depletion of ozone layer is emissions from jet aeroplanes. Chlorofluorocarbons have the largest ozone depletion potential (ODP). Chlorofluorocarbons when released from air conditioners, refrigerators, spray cans and industrial solvents drift in the stratosphere very slowly. Therefore, each chlorine atom from chlorofluorocarbons gets sufficient time to destroy a large number of ozone molecules (approx. 100,000). The first chlorofluorocarbons produced in 1931 are still in the sky today. Now, all over the world, the use of chlorofluorocarbons is being banned.

• Ozone in our atmosphere is formed by interaction between oxygen molecules and ultraviolet light as follows :



- Single atoms of oxygen are very reactive and combine with O_2 to form O_3 i.e., ozone

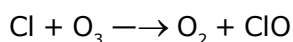
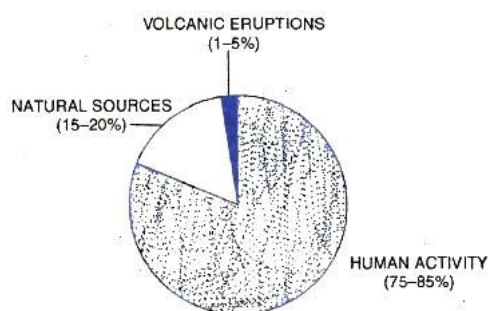


CAUSES OF OZONE DEPLETION

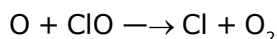
There are three main causes of ozone depletion :

1. **Human activity** is by far the most prevalent and destructive source of ozone depletion, while threatening volcanic eruptions are less common. Human activity, such as the release of various compounds containing chlorine or bromine, accounts for approximately 75 to 85 per cent of ozone damage. Perhaps the most evident and destructive molecule of this description is chlorofluorocarbon (CFC). CFCs were first used to clean electronic circuit boards, and as time progressed, were used in aerosols and coolants, such as refrigerators and air conditioners.

- When CFCs from these products are released into the atmosphere, the destruction begins .
- As CFCs are emitted, the molecules float toward the ozone rich stratosphere.
- Then, when UV radiation contacts the CFC molecule, this causes one chlorine atom to liberate.
- This free chlorine then reacts with an ozone (O_3) molecule to form chlorine monoxide (ClO) and a single oxygen molecule (O_2). This reaction can be illustrated by the following chemical equation



- Then, a single oxygen atom reacts with a chlorine monoxide molecule, causing the formation of an oxygen molecule (O_2) and a single chlorine atom



- This threatening chlorine atom then continues the cycle and results in further destruction of the ozone layer.
- Measures have been taken to reduce the amount of CFC emission, but since CFCs have a life span of 20-100 years, previously emitted CFCs will do damage for years to come.

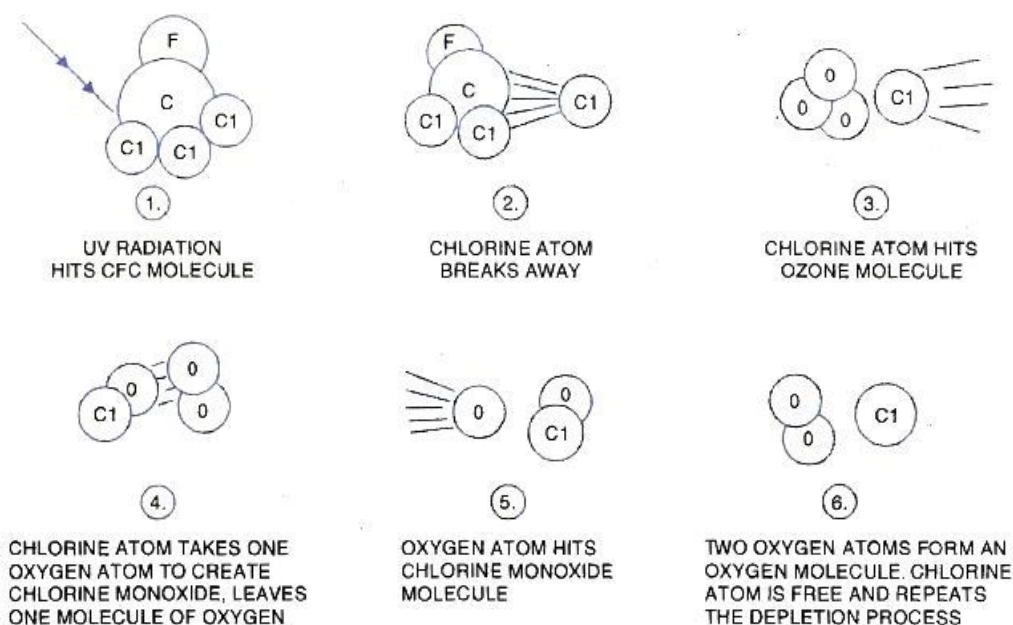


Fig. 3.7 INTRACTION OF CFCs AND UV RADIATIONS DAMAGING THE OZONE LAYER.



2. **Natural sources** also contribute to the depletion of the ozone layer, but not nearly as much as human activity. Natural sources can be blamed for approximately 15 to 20 per cent of ozone damage. A common natural source of ozone damage is naturally occurring chlorine. Naturally occurring chlorine, like the chlorine released from the reaction between a CFC molecule and IN radiation, also has detrimental effects and poses danger to the earth.

3. **Volcanic eruptions** are a small contributor to ozone damage, accounting for one to five per cent. During large volcanic eruptions, chlorine, as a component of hydrochloric acid (HCl), is released directly into the stratosphere, along with sulphur dioxide. In this case, sulfur dioxide is more harmful than chlorine because it is converted into sulphuric acid aerosols. These aerosols accelerate damaging chemical reactions, which cause chlorine to destroy ozone.

A Little further 3.4

Among the ozone depleting substances (ODS) chlorofluorocarbons are the most harmful. Give reason.

Explanation

Chlorofluorocarbons produce 'active chlorine' (Cl and ClO radicals) in the presence of UV radiations. These radicals, through chain reactions, then destroy the ozone by converting it into oxygen. This is the reason why chlorofluorocarbons are the most harmful ODS.

IMPACT OF OZONE DEPLETION

Some of the environmental, social and economic effects of ozone depletion are :

1. **Plant growth and productivity.** UV radiations can affect plant growth and productivity.
2. **Marine food chain.** Phytoplanktons are microscopic plants that form the basis of the marine food chain. These are particularly susceptible to increases in UV radiation. Reduced phytoplankton numbers would significantly affect other marine species, including commercial fish stocks.
3. **Human health.** At high exposure levels, UV radiations can weaken the human immune system and causes skin cancer, cataracts and eye cancer. Increased levels of UV radiation will contribute to rising incidences of skin cancer.
4. **Deterioration of materials.** Increased UV radiations can accelerate the deterioration of plastics, wood, paper, cotton and wool.

CONTROL OF OZONE DEPLETION

The currently available substitutes of chlorofluorocarbons are hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs). HCFCs contain one chlorine atom less than CFCs and are less harmful than CFCs. HFCs have no chlorine and hence ozone friendly. So, the ideal solution seems to be to use HFCs. But all the three gases are greenhouse gases and have global warming potential.

Montreal Protocol. In 1987, 27 countries signed international agreement to protect stratospheric ozone. The main points were :

- To limit the production and use of ozone depleting substances.
- Phasing out of ozone depleting substances.
- Helping the developing countries to implement use of alternatives as CFCs.

Uptill now more than 175 countries have signed the Montreal Protocol.

In 1987, the United Nations Environment Programme (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 levels.

EFFECT OF REGULATIONS TO CONTROL OZONE DEPLETION

- Tasmania lies in the region of the Southern Hemisphere where the first signs of ozone recovery are most likely to be detected, possibly around 2010-2015.
- There has been a rapid decline in the amount of ozone over the Antarctic regions since the 1970s, leading to the formation of the ozone 'hole'.



- Between 1998 and 2001 the ozone hole covered an area of up to 26 million km², nearly three times the area of Australia.
- Despite the reduction in use and emissions of ODSs (Ozone depletion substances), it is likely that evidence of ozone recovery will not be seen until about 2010-2015, as the various ODSs causing the decline continue to persist in the atmosphere.
- In the meantime, Tasmania will experience minimum ozone levels for the next 10 to 15 years.
- There is uncertainty about the timing of the recovery of the ozone layer. The size and duration of the Antarctic ozone 'hole' was greatly reduced in 2002, but recovery of the ozone layer remains inconclusive. (in the 2003 ozone hole was the largest yet recorded).

LAND POLLUTION

With the rise in population there has been increase in solid wastes from domestic and commercial wastes which lead to land pollution. It is a serious problem specially in large cities where disposable containers are used. Heaps of wastes are found to be lying here and there. Many of the wastes do not decompose at all while the organic wastes which decompose release foul smell. Few wastes when burnt, release harmful fumes. Problem of land pollution needs to be sorted out scientifically.

VARIOUS CAUSES OF LAND POLLUTION

1. Solid wastes from industrial, agricultural field etc.
2. Cow dung from cattle shed.
3. Sewage.
4. Various waste materials like plastics, papers, clothes, rubber, metals, peelings of fruits and vegetables are responsible for land pollution.
5. Unserviceable wooden articles.
6. Leftover eatables.
7. Food items spoilt due to fungal growth.
8. Sand and bricks.
9. Empty bottles.
10. Leather goods.
11. Ash.

EFFECTS OF LAND POLLUTION

1. Foul smell released by decomposition of organic wastes.
2. Blocking of the flow of water in the drains.
3. Dirty surroundings.
4. Breeding grounds of houseflies, mosquitoes.
5. Consumption of polluted water leads to spreading of various water borne diseases like cholera, diarrhoea and dysentery.
6. Burning of some wastes leads to production of smoke which is harmful for health.
7. Certain chemicals like lead, sulphur which are released from various industries finally come to land and act as land pollutants.

CONTROL OF LAND POLLUTION

1. Use of biodegradable wastes.
2. Recycling of certain waste products like plastics and paper help in controlling water pollution.
3. Organic wastes can be sent to biogas plants.
4. Molten plastic wastes and asphalt can be used for making roads.
5. Volume of wastes can be reduced by burning them at high temperature. This is known as **incineration**.



In this method huge volumes of waste materials from houses, hospitals, industries are burnt and thus leaving behind less amount of ash.

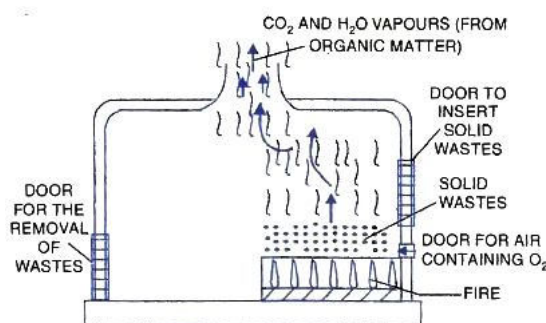


Fig. 3.8 INCINERATOR

This can be done in an incinerator.

6. Biodegradable and non-biodegradable wastes should be disposed of separately.
7. Various metals can be melted and recycled.
8. Organic wastes can be buried and used as a manure after the process of composting.
9. Use of manures and bio-fertilizers can reduce the need for chemical fertilizers.
10. By improving the mining techniques, spread of mine dust can be reduced.

MANAGEMENT OF GARBAGE PRODUCED

Solid wastes generated by domestic, commercial and industrial activities are often indiscriminately disposed. Unscientific management of such wastes leads to serious environmental problems. The problems are already acute in cities and towns, as the disposal facilities are not keeping pace with the quantum of waste being generated. It is very common to find large heaps of garbage in disorganized manner at every nook and corner of the cities.

In sanitary method being adopted for disposal of solid wastes is a serious health concern. Particularly, during rainy season, run-off and high humid conditions increase the health hazards. The landfill sites, which are not well maintained, are prone to groundwater contamination due to leachate percolation. Open dumping of garbage serves as breeding ground for disease vectors such as flies, mosquitoes, cockroaches, rats and other pests.

High risks of spreading diseases like typhoid, cholera, dysentery, yellow fever, encephalitis, plague and dengue fever may not be ruled out. There are three major steps involved in the management of garbage viz. collection, transportation and disposal.

QUANTITY

It is estimated that solid waste generated in small, medium and large cities and towns is about 0.1 kg, 0.3-0.4 kg and 0.5 kg per capita per day respectively.

Description	Per cent by weight
Vegetable, leaves	40.15
Grass	3.80
Paper	0.81
Plastic	0.62
Glass, ceramics	0.44
Metal	0.64
Stones, ashes	41.81
Miscellaneous	11.73

COMPOSITION

The composition of garbage in India indicates lower organic matter and high ash or dust contents. It has been estimated that recyclable content in solid wastes varies from 13 to 20% and combustible material is about 80-85%. A typical composition of municipal solid waste is given below.



PRESENT GARBAGE MANAGEMENT PRACTICES

Collection of Garbage

Garbage is generated from residential and commercial complexes. Current practices in residential areas for collection of garbage differ from city to city.

Collection Centres

Each city has its own system for setting up of waste collection centers. The waste is collected from communities in a smaller bin, which is then transported, to larger bins known as secondary collection facility.

Transportation of Garbage

Transportation of waste from collection centers to final disposal site is another important step in the management of garbage. It has been estimated that approximately 60% of waste is collected for transportation to the disposal sites.

Disposal of Garbage

The disposal of garbage in a well-managed land, adopting scientific methods of operation is termed as sanitary land-fill (SLF). Most important aspect relating to landfill is, identification of a suitable site. Landfilling is a slow and time consuming process.

Most of the landfill sites in India are uncontrolled dumps and are not sanitary landfills where domestic, commercial, industrial and hospital wastes are dumped together. The garbage on such sites is not properly speedy and compacted. Thus, sites identified for filling are not properly maintained.

Community Participation

- Creating mass awareness, ensuring public participation in segregation of recyclable material and storage of waste at source;
- Ensuring public participation in community based primary collection system;
- Organizing ragpickers for collection of recyclable material at the community level;
- Providing health education to the ragpickers and suggesting tools for safety;
- Providing employment through organizing door to door collection of waste; and encouraging minimization of waste through in-house backyard composting, vermiculture and biogas generation etc;
- Recycling;
- Wealth from wastes: technologies;
- In the recent past, private sectors have taken initiatives to use the garbage as profitable venture, Incineration, Composting, Vermiculture.

Sewage treatment includes the following three steps :

(a) Primary treatment.

It includes sedimentation, filtration, floatation and passing wastes through thick layer of gravel. After this, sewage is neutralized.

(b) Secondary (Biological) treatment.

Neutralized material is sent to Upflow Anaerobic Sludge Blanket (UASB) where anaerobic bacteria act on biodegradable material. Mixing wastes with sludge containing bacteria and algae for consumption of organic matter and release of oxygen can prove to be useful in treatment of sewage. Digestion of organic material by bacteria is called biological or secondary treatment.

(c) Tertiary treatment.

Chlorination, evaporation, exchange and absorption constitute tertiary treatment. This treatment is meant for disinfection of the wastes and the removal of all inorganic wastes.

With changing time we depend mainly on disposable and packed materials which are nonbiodegradable. This has negative impact on our environment. Because of the rising problems arising as a result of disposal of non-biodegradable materials, like plastic cups used for tea, some alternative ways were thought. **Kulhads** made of clay replaced **plastic cups**. But later it was realized that making of lot of Kulhads led to loss of fertile top soil. This idea was dropped and presently disposable paper cups are used. These can be recycled and does not cause any environmental hazard.



N.C.E.R.T TEXT BOOK SOLUTION

Q.1 Why are some substances biodegradable and some non-biodegradable?

Ans. Biodegradable substances are organic substances obtained from plants and animals wastes which are degraded by microorganisms like bacteria and fungi. The microorganisms present in our environment secrete enzymes that degrade wastes into simpler substances. These substances increase the fertility of soil. Whereas there are some substances which are not broken down into simpler substances by the action of microorganisms and persist as such in the environment. They are called non-biodegradable substances. For example, plastic, glass, synthetic chemicals, aluminium cans, etc. These substances, thus persist in the environment and pollute it.

Q.2 Give any two, ways in which biodegradable substances would affect the environment

Ans. The two ways in which biodegradable wastes pollute the environment are as follows:

(i) Decomposition of these wastes produces foul smell which spreads in the surroundings and makes the life of people miserable.

(ii) Heaps of garbage acts as a breeding ground for flies and other parasites. They carry number of pathogens and spread diseases such as diarrhoea, typhoid, cholera, tuberculosis, etc.

Q.3 Give any two ways in which non-biodegradable substances would affect the environment

Ans. (i) Some of the non-biodegradable chemicals like pesticides (DDT) and heavy metals enter the food chain and biomagnify in each trophic level. They accumulate in the body tissues of living organisms and cause various diseases. Humans are harmed the most because humans lie at the top of food chain.

(ii) Excessive use of non-biodegradable fertilisers and pesticides affect the fertility of soil and subsequently reduce the crop yield. The soil may become acidic or alkaline.

Q.4 What are trophic levels? give an example of a food chain and state the different trophic levels in it.

Ans. The distinct sequential steps of a food chain where transfer of energy occurs are called trophic levels.

Let us consider a food chain:

Plants → Rabbit → Fox → Lion

In the above food chain, plants are the producers which convert solar energy into chemical energy of organic compound by the process of photosynthesis. Thus, they form the first trophic level in the food chain. A rabbit is a herbivore (primary consumer) and eats plants. Here transfer of energy occurs from the plant to herbivore. Thus rabbit belongs to second trophic level. Rabbit, in turn, is eaten by the fox (secondary consumer) a carnivore, thus, fox belongs to third trophic level. Lion is the top carnivore which eats fox and represents fourth trophic level.

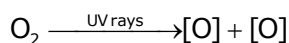
Q.5 What is the role of decomposers in the ecosystem?

Ans. Decomposers are microorganisms (bacteria and fungi) which obtain nourishment from organic remains. They are essential components of an ecosystem. They decompose dead remains of plants and animals into simple inorganic compounds hence act as cleansing agents of environment. These simple compounds are released into the environment (soil, air, water) from where they are used by the producers as raw materials. Thus, they help in cycling of nutrients in an ecosystem and make the soil fertile.

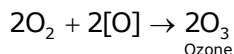


Q.6 What is ozone and how does it affect any ecosystem?

Ans. Ozone is an isotope of oxygen containing three atoms of oxygen (O_3). It is present in the stratosphere about 16-50 km of height above equator and 8-30 km above poles where it is formed from O_2 by the action of high energy UV rays.



Ozone is formed when atomic oxygen combines with oxygen.



The ozone layer protects all forms of life on earth from harmful UV radiations coming from the sun. Certain harmful chemicals such as CFCs (chlorofluorocarbons), methane (CH_4), oxides of nitrogen (NO_x), etc., released by various human activities are destroying the ozone layer and making it thin. As a result, more and more harmful radiations (UV radiations) are reaching the earth surface that are responsible for causing various diseases such as skin cancer, cataract, damage to immune system in human beings and animals. They also result in increased rate of embryonic mortality, decreased photosynthesis in plants and also contribute towards global warming.

Q.7 How can you help in reducing the problems of waste disposal? Give any two methods.

Ans. Waste disposal is the biggest problem of all local bodies. We can help in reducing the problem of waste disposal by changing our lifestyle and attitude.

(i) We should try to minimise use of non-biodegradable articles and switch over to use of such articles that can be recycled or are made of biodegradable materials.

(ii) The kitchen wastes should be converted into compost that can be used in gardens and lawns. The non-biodegradable wastes should be disposed off properly, for example, landfill, burning and incineration.

Q.8 What will happen if we kill all the organism of one trophic level?

Ans. If we kill all the organisms in one trophic level, the transfer of food to the next trophic level will stop. There will be overpopulation of individuals belonging to the previous trophic level which would have been eaten otherwise. Thus, the ecological balance will be disturbed because the increase in number of organisms will be much beyond the carrying capacity of the environment. There will be no transfer of food from one trophic level to another.

Q.9 Will the impact of removing all the organisms in a trophic level be different for different trophic levels? Can the organisms of any trophic level be removed without causing any damage to the ecosystem?

Ans. The impact of removing all the organisms in a trophic level will differ from organism to organism. If an organism is removed from an ecosystem, it will definitely affect the transfer of energy and nutrients in the environment because all of them are linked together in a food chain. Thus, the removal of an organism from a trophic level will ultimately affect the ecosystem. For example, removal of producers will kill all the consumers. If all the herbivores are removed, then all the carnivores will die due to starvation. Killing of carnivores will increase the number of herbivores that in turn will eat up all the producers.

No, all the organisms of any trophic level cannot be removed without causing any damage to the environment as they are linked through a food chain and survival of organisms of one trophic level depends on the existence of the members of other trophic level.



Q.10 What is biological magnification? Will the levels of this magnification be different at different levels of the ecosystem?

Ans. Biological magnification is the phenomenon that involves gradual increase in the concentrations of harmful non-biodegradable chemical substances at different trophic levels in a food chain. Yes, the level of this magnification will be different at different trophic levels. It will be minimum in the first trophic level (producers) and maximum in last trophic level (i.e., top carnivore or omnivore). For example, in a study it was found that concentration of DDT was 0.02 ppm in water, 5.0 ppm in phytoplanktons, 240 ppm in fishes and 1600 ppm in fish eating birds.

Q.11 What are the problems caused by the non-biodegradable wastes that we generate?

Ans. (i) Non-biodegradable chemicals enter the food chain, biomagnify and affect human beings and other living components of the environment.

(ii) Excessive use of non-biodegradable fertilisers and pesticides affect the fertility of soil and subsequently, reduce the crop yield by making soil acidic or alkaline.

(iii) The volume of non-biodegradable wastes are not decreased by natural process of decomposition.

(iv) Non-biodegradable pesticides and other toxins pollute underground water along with surface water and make them unfit for use.

(v) Recycling of these non-biodegradable materials produces only inferior quality products. During recycling, they produce various toxins which may be carcinogenic in nature.

Q.12 If all the waste we generate is biodegradable, will this have no impact on the environment?

Ans. If all the waste we generate is biodegradable, it will still have some adverse effect on the environment. The impact on the environment will depend upon system of collecting, transporting and disposal of biodegradable waste. If the degradation is regular and clean, then the impact will be little in urban areas. Only some effects will be observed at disposal site that will release foul smell and some gases that can contaminate sanitary workers. These contaminations can be reduced by use of machines and wearing protective gear by workers. If the degradation is not regular, it acts as a breeding ground for flies, insects and microbes which cause various diseases. Moreover, the rotting biodegradable wastes emit foul smell which makes the life of people miserable.

Q.13 Why is damage to the ozone layer a cause for concern? What steps are being taken to limit this damage?

Ans. Air pollutants like CFCs, CH_4 , oxides of nitrogen (NO_x) are causing depletion in ozone layer that allows large amount of UV radiation on the earth. At present, ozone depletion is matter of concern because it causes various problems in plants and animals. The harmful UV rays cause increased number of skin cancers, cataracts, reduced immunity and mutations in humans and also affect photosynthesis in plants. To minimise the ozone depletion, several developed as well as developing countries agreed to obey the steps being taken to limit the use of CFCs and halons. Refer to text.



EXERCISE – I**NTSE /OLYMPIAD /FOUNDATION PROBLEMS****MULTIPLE CHOICE QUESTIONS**

- The effect of pollution is first and most marked on:

(A) natural flora of a place (B) natural balance of our environment
(C) natural geochemical cycles (D) all the above.
- Ozone layer is destroyed due to :

(A) CFC (B) CO₂ (C) SO₂ (D) NH₃.
- Threat for the existence of human being is :

(A) low forest (B) high population and pollution
(C) deforestation (D) high population.
- Air pollution is maximum caused by :

(A) household detergents and pesticides
(B) automobile exhausts and chemicals from industries
(C) sewage and pesticides
(D) sewage and industrial effluents.
- Which of the following groups contain only biodegradable items ?

(A) grass, flowers, leather (B) glass, wood, plastic
(C) fruit peels, cake, lime juice (D) cake, wood, grass.
- Which of the following constitute a food chain ?

(A) grass, wheat, mango (B) grass, goat, human
(C) goat, cow, elephant (D) grass, fish, goat.
- Which of the following are environment friendly practices?

(A) Carrying cloth bags to put purchases in while shopping.
(B) Switching off unnecessary lights and fans.
(C) Walking to school instead of getting your mother to drop you on her scooter.
(D) All the above.
- Which of the following is an omnivorous animal ?

(A) Deer (B) Cat (C) Lion (D) Goat.
- Which of the following is not an abiotic component of an ecosystem ?

(A) Plants (B) Soil (C) Air (D) Sunlight.



10. Which of the following is a man made ecosystem?
(A) Pond (B) Aquarium (C) Lake (D) Forest.

FILL IN THE BLANKS

1. Sunlight, temperature, rainfall, humidity are factors of environment.
2. of solar energy is fixed by plants.
3. of energy is transferred from one trophic level to another.
4. Interconnected food chains form
5. Out of glass, D.D.T. and paper, the biodegradable waste is
6. Out of wheat, cattle dung, aluminium foil and bagasse, the non-biodegradable waste is
7. Animals which feed on dead animals are called

ANSWER KEY**MULTIPLE CHOICE QUESTIONS**

- | | | | | | | |
|------|------|-------|------|------|------|------|
| 1. B | 2. A | 3. B | 4. B | 5. C | 6. B | 7. D |
| 8. B | 9. A | 10. B | | | | |

FILL IN THE BLANKS

- | | | | |
|------------|-------------------|----------------|-------------|
| 1. Abiotic | 2. One per cent | 3. 10 per cent | 4. Food web |
| 5. Paper | 6. Aluminium foil | 7. Scavengers | |



EXERCISE – II**PRACTISE FOR SUMMATIVE ASSESSMENT****VERY SHORT ANSWER QUESTIONS**

1. Name various components of environment.
2. Name two main abiotic factors which affect human environment.
3. What do you understand by the term ecological imbalance?
4. What do you understand by term sociocultural environment ?
5. Define biomagnification.
6. List the constituents of biotic environment.
7. What are ecological pyramids?
8. What are primary and secondary consumers ?
9. Expand UASB.
10. What do you understand by biological magnification ?

SHORT ANSWER QUESTIONS

1. What will happen if we kill all organisms in one trophic level ?
2. What are the problems caused by the nonbiodegradable wastes we generate ?
3. How recycling of waste materials help in ecological balance ?
4. Explain how ozone layer acts as our saviour ?
5. How can you make a balance between environment and development ?

LONG ANSWER QUESTIONS

1. In the food chain given below, grass provides 4000 J of energy to grasshopper. How much energy will be available to snakes from frogs ?

Grass → Grasshopper → Frogs → Snakes.

2. Explain why food chains with more than six food chains are rare.



EXERCISE – III**PRACTISE FOR SUMMATIVE ASSESSMENT****SECTION-A**● **Fill in the blanks**

- The biodegradable substances were broken down by the activity of _____ secreted by _____.
- Increase in temperature of earth due to green house gases is called _____.
- The series of organism feeding on one another is called _____.
- UNEP stands for _____.
- The process by which producers prepare their own food in presence of sunlight is called _____.
- All interacting organism in an area together with abiotic components of an environment forms an _____.
- Ozone is getting depleted due to _____ used in refrigerants and in fire extinguishers.
- The process by which the harmful chemicals entered in food chain are not degradable and get accumulated progressively at each level is called _____.
- Herbivores, carnivores, omnivores and parasites are examples of _____.
- _____ can be taken as average value for the amount of organic matter that is present at each step and reaches the next level of consumers.

SECTION-B● **Multiple choice question with one correct answers**

- The best source of energy is
(A) Water (B) Soil (C) Plants (D) Ponds
- Ozone hole means
(A) Hole in the stratosphere (B) Same concentration of ozone
(C) Decrease in concentration of ozone (D) Increase in concentration of ozone
- As a biologist, if you become very interested in the study of the interaction of organism with each other and the environment your subspeciality will be
(A) Zoology (B) Ecology (C) Protany (D) Herpetology
- As energy is passed from one trophic level to another, the amount of usable energy
(A) Increases
(B) Decreases
(C) Remains same
(D) Energy is not passed from one trophic level to another
- In the biosphere which of the following is the ultimate source of energy
(A) Carbon (B) Water (C) Sunlight (D) Nitrogen
- Individual of any species at a place form
(A) Biotic community (B) Ecosystem (C) Population (D) Biome
- Pyramid of energy are
(A) always upright (B) always inverted
(C) mostly upright (D) mostly inverted
- The maximum energy is stored at the following trophic level in an ecosystem
(A) Producers (B) Herbivores (C) Carnivores (D) Top carnivores
- Sun gives radiations in form of
(A) Infra-red radiation (B) Visible light
(C) Ultra-violet (D) All of the above
- Minimum energy is transferred in step:



- (A) Grass ® deer (B) Deer ® lion (C) Grass ® Lion (D) Sun ® Plant

SECTION-C

• **Multiple choice question with one or more than one correct answers**

- Ozone depletion can lead to
(A) Skin cancer (B) Eye cataract (C) Blood cancer (D) Brain cancer
- The abiotic factors include
(A) Temperature (B) Water (C) Soil (D) Bacteria
- Organisms which produce their own food are called
(A) autotrophs (B) herbivores (C) producers (D) decomposers
- Which of the following is correct for decomposers?
(A) help in natural replenishment
(B) convert complex organic substances into simple organic substance
(C) synthesize organic compound from inorganic substances
(D) comprising of microorganisms like bacteria and fungi

SECTION-D

• **Assertion & Reason**

Instructions: In the following questions as Assertion (A) is given followed by a Reason (R). Mark your responses from the following options.

- (A) Both Assertion and Reason are true and Reason is the correct explanation of 'Assertion'
(B) Both Assertion and Reason are true and Reason is not the correct explanation of 'Assertion'
(C) Assertion is true but Reason is false
(D) Assertion is false but Reason is true
- Assertion:** Each step or level of the food chain forms a trophic level. Generally there are four trophic level in a food chain.
Reason: Very less energy remains after fourth trophic level.
 - Assertion:** The length and complexity of food chain vary greatly
Reason: It food web is more stable.
 - Assertion:** Increase in temperature of earth is due to green house gases.
Reason: Ozone increase due to chlorofluoro carbon used in refrigerants and in fire extinguishers.
 - Assertion:** Supersonic jet cause pollution as they thin out ozone.
Reason: Depletion of ozone cause cataract.
 - Assertion:** Each ecosystem contain only biotic components
Reason: The autotrophs synthesize food material while heterotrophs utilise and resynthesize it.

SECTION-E

• **Match the following (one to one)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. Only One entries of column-I may have the matching with the some entries of column-II and one entry of column-II Only one matching with entries of column-I

1. Column I

- (A) Autotroph
(B) Ozone
(C) UNEP

Column II

- (P) Chlorofluoro carbon
(Q) United Nations environment programme
(R) Ist Tropic level



- (D) CFC
- 2. Column I**
- (A) Abiotic factor
(B) Natural ecosystem
(C) Ozone protects us from
(D) Trophic level

- (S) Three atoms of oxygen (O_3)
- Column II**
- (P) Food chain
(Q) Forest, Ponds and Lakes
(R) Physical factors
(S) Ultraviolet radiation

SECTION-F

• **Comprehension**

Every thing that surrounds the organism and influences its life in some way or the other is called environment. When we add waste to the environment it gets polluted. There are two types of waste one those are biodegradable which can be broken down by the action of enzymes produced by bacteria while other are non-biodegradable which may be inert and simply persist in the environment for a long time or may harm the various members of the ecosystem.

An ecosystem consists of biotic components and abiotic components. Ponds, lakes and forests are examples of natural ecosystem while garden and crop-fields are examples of artificial ecosystem.

- Define ecosystem
- Difference between biodegradable and non-biodegradable substances.
- Name the two components of ecosystem.
- The study of the interactions of living organism and their environment is called

(A) Biology (B) Ecology (C) Histology (D) Embryology

SECTION-G

• **Match the following (one to many)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. One or more than one entries of column-I may have the matching with the some entries of column-II and one entry of column-II may have one or more than one matching with entries of column-I

- | 1. Column I | Column II |
|---------------------|------------------|
| (A) Biodegradable | (P) Producers |
| (B) Ecofriendly | (Q) Decomposers |
| (C) Trophic level's | (R) Bioplastics |
| (D) Fungi | (S) Paper bags |



Answers

Section-A

- | | |
|------------------------------|---|
| 1. Enzyme, Microorganism | 2. Green house effect |
| 3. Food chain | 4. United Nations environment programme |
| 5. Photosynthesis | 6. Ecosystem |
| 7. Chlorofluoro carbon (CFC) | 8. Biomagnification |
| 9. Consumers | 10. 10% |

Section-B

- | | | | | |
|--------|--------|--------|--------|---------|
| 1. (C) | 2. (C) | 3. (B) | 4. (B) | 5. (C) |
| 6. (D) | 7. (A) | 8. (A) | 9. (D) | 10. (D) |

Section-C

- | | | | |
|----------|------------|----------|------------|
| 1. (A,B) | 2. (A,B,C) | 3. (A,C) | 4. (A,B,D) |
|----------|------------|----------|------------|

Section-D

- | | | | | |
|--------|--------|--------|--------|--------|
| 1. (A) | 2. (B) | 3. (C) | 4. (B) | 5. (D) |
|--------|--------|--------|--------|--------|

Section-E

- (A)-(R), (B)-(S), (C)-(Q), (D)-(P)
- (A)-(R), (B)-(Q), (C)-(S), (D)-(P)

Section-F

- (B)

Section-G

- (A)-(RS), (B)-(RS), (C)-(PQ), (D)-(Q)



EXERCISE – IV**FOR OLYMPIAD ASSESSMENT**

1. Insectivorous plants grow only in soils deficient in :-
 (A) calcium (B) phosphorus (C) nitrogen (D) copper
2. Biomass produced by plants in oceans accounts for :-
 (A) 85% (B) 75% (C) 65% (D) 55%
3. Geothermal energy is :-
 (A) non-renewable non-conventional energy source
 (B) non-renewable conventional energy source
 (C) renewable non-conventional energy source (D) renewable conventional energy source
4. Inexhaustible, non-conventional source of energy is :-
 (A) solar radiations (B) wind power (C) sea tides (D) all the above
5. Soil is composed of :-
 (A) mineral + water + air (B) mineral + organic matter + air
 (C) mineral + organic matter + air + water (D) organic matter + water
6. Plants growing in extremely cold soils are :-
 (A) halophytes (B) psammophytes (C) oxylophytes (D) psychrophytes
7. Which one of the following animals can live from birth to death without even drinking water :-
 (A) Kangaroo rat (B) Kangaroo (C) Camel (D) Desert cat
8. Energy and nutrients enter a community by way of the :-
 (A) producers (B) consumers (C) detritivores (D) scavengers
9. Which is the correct sequence in the food chain in grassland ?
 (A) Grass ® wolf ® deer ® buffalo (B) Grass ® insect ® bird ® snake
 (C) Grass ® snake ® insect ® deer (D) Bacteria ® grass ® rabbit ® wolf
10. There is no difference between the following :-
 (A) primary consumers and herbivores (B) trophic level I and herbivores
 (C) primary carnivores and trophic level II (D) Secondary consumers and herbivores
11. Driving force of ecosystem is :-
 (A) carbohydrate in plants (B) biomass
 (C) solar energy (D) producer
12. An aquatic plant with floating leaves :-
 (A) have stomata on leaf surface (B) have stomata on lower surface
 (C) have stomata (D) have stomata only on upper surface
13. Acid rain is caused due to increase in concentration of :-
 (A) SO_2 and NO_2 (B) CO and CO_2 (C) CO and SO_3 (D) ozone and dust
14. Which is NOT a green house gas ?
 (A) CO_2 (B) H_2 (C) CFC (D) Methane
15. Lichens are important in the studies on atmospheric pollution because they :-
 (A) can also grow in greatly polluted atmosphere
 (B) can readily multiply in polluted atmosphere



- (C) are very sensitive to pollutants like SO_2
(D) efficiently purify the atmosphere
- 16.** The study of interrelationship between living organisms and their environment is called
(A) phytogeography (B) ecology (C) phytosociology (D) ecosystem
- 17.** Abiotic component in an ecosystem is
(A) water (B) daphnia (C) bacteria (D) chlorella
- 18.** Who had proposed the term ecosystem?
(A) Gardner (B) Tansley (C) Odum (D) Krebs
- 19.** Which one of the following is the definition of ecosystem?
(A) A localised association of several plants and animals
(B) Different communities of plants, animals and microbes, together with their physicochemical environments
(C) Different communities of plants and microbes, plus their physicochemical environments
(D) A community of organisms interacting with one another
- 20.** Good soil is
(A) which allows the limited amount of water into it
(B) which allows to percolate the water slowly from it
(C) which allows to pass water very quickly from it
(D) which holds whole of water into it
- 21.** Humus is an example of
(A) crystalloids (B) organic colloids (C) soil structure (D) none of them
- 22.** Plants growing in shady regions are
(A) sciophytes (B) xerophytes
(C) heliophytes (D) epiphytes
- 23.** Plants occurring on soils rich in salts are known as
(A) heliophytes (B) halophytes (C) geophytes (D) thermophytes
- 24.** Which of the following is the most characteristic feature of a xeric environment?
(A) Low atmospheric humidity (B) Extremes of temperature
(C) The precipitation (D) High rate of vaporisation
- 25.** Mechanical tissues are very poorly developed in :-
(A) xerophytes (B) halophytes (C) hydrophytes (D) lithophytes
- 26.** Xerophytes have long roots
(A) due to -light (B) to draw water from deep water beds
(C) to give mechanical support (D) none of the above
- 27.** Mangrove plants show vivipary. This is
(A) germination of seeds within fruits while still attached to parent plant
(B) germination of seeds in fruits on the soil
(C) germination of seeds within fruit on sterile artificial culture medium
(D) germination of seeds only after dispersal of fruits
- 28.** The orchid plants, which are found growing on the trees, are



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- (A) parasites (B) epiphytes (C) saprophytes (D) lithophytes
29. In submerged hydrophytes functional stomata are found
(A) on lower surface of leaf (B) on both the surface of leaf
(C) no where on the plant (D) on upper surface of leaf
30. A food chain consists of
(A) producers and primary consumers (B) producers, herbivores and carnivores
(C) producers, consumers and decomposers (D) producers, carnivores and decomposers
31. Which of the following is the correct sequence in food chain?
(A) Fallen leaves → bacteria → insect larvae → birds
(B) Phytoplankton → zooplankton → fish
(C) Grasses → fox → rabbit
(D) Grasses → chameleon → insects birds
32. Which is a primary consumer?
(A) Scavenger (B) Saprophyte (C) Carnivore (D) Herbivore
33. Energy and nutrients enter a community by way of the
(A) producers (B) consumers (C) detritivores (D) scavengers
34. When a big fish eats a small fish, which eats water fleas supported by phytoplankton, the water fleas are
(A) primary consumers (B) secondary consumers
(C) top consumer in this food chain (D) producers
35. In natural ecosystem, decomposers include
(A) only microscopic animals
(B) only bacteria and fungi
(C) the above two types of organisms plus microscopic animals
(D) only the above two types of organisms
36. The food chain in which microorganisms break down the energy rich compounds synthesised by producers is
(A) detritus food chain (B) predator food chain
(C) consumer food chain (D) parasitic food chain
37. In an aqueous environment, microscopic animals and plants are collectively known as
(A) herbivores (B) fauna and flora (C) planktons (D) symbionts
38. Water logged soil is
(A) physically as well as physiologically dry (B) physically wet but physiologically dry
(C) physically dry (D) physically as well as physiologically wet
39. Carbon dioxide in atmospheric air amounts to about
(A) 0.03% (B) 0.003% (C) 0.3% (D) 3%
40. The presence of ozone in the atmosphere of earth
(A) is advantageous since it supplies O₂ for people travelling in jets
(B) helps in checking the penetration of ultraviolet rays to earth
(C) hinder higher rate of photosynthesis
(D) has been responsible for increasing the average global temperature in recent years
41. The term biodiversity refers to the



- (A) Variations in man
(B) A species found in a particular area
(C) Variety of different types of organism found on earth
(D) All of the above
- 42.** Silent valley-which contains very rare species of plants and animals, is situated in
(A) Kerala (B) Rajasthan (C) Jammu and Kashmir (D) Bombay
- 43.** "Chipko Movement" is concerned with
(A) plant conservation (B) project tiger (C) animal breeding (D) plant breeding
- 44.** A biosphere in nature may be compared with a
(A) Bacteria (B) Cell (C) Nucleus (D) Cell wall.
- 45.** The biosphere includes
(A) Pedosphere (soil) (B) Hydrosphere (C) Atmosphere (D) All of these
- 46.** A natural forest is an example of
(A) Hydrosphere (B) Biotic community (C) Ecosystem (D) All of these
- 47.** The Sahara desert is an example of
(A) Population (B) Biotic community (C) Biosphere (D) Biome
- 48.** The 'producers' in general are
(A) Autotrophic animals (B) Heterotrophic plants
(C) Heterotrophic animals (D) Autotrophic plants
- 49.** Man in everyday life produces food synthetically. On the basis of this can man be called a producer?
(A) Yes (B) No
(C) Insufficient information to answer (D) Cannot be definitely said.
- 50.** Suppose all consumers of the earth are dead. Then
(A) Producers will not prepare food
(B) Decomposers will die
(C) There will be no sunlight available by photosynthesis.
(D) None of these
- 51.** Why does a goat not eat a tiger?
(A) Because the tiger is more powerful than the goat
(B) Because the goat is not adapted to eat flesh.
(C) Because every goat is taught by its parents to keep away from tigers.
(D) All of these
- 52.** The correct food chain out of the following is
(A) Tiger → Cat → Lion → Goat (B) Grass → Insects → Lizard → Snake
(C) Grass → Rabbit → Lion → Man (D) Sun → Plant → Insect → Man
- 53.** Many food chains form a
(A) Bigger food chain (B) Food net (C) Food space (D) Food web
- 54.** Following is an incomplete food chain:
Grass → ? → Jackal → tiger. The choice for the correct answer will be



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- (A) Lion (B) Deer (C) Rat (D) Cockroach
55. The loss of energy in successive steps of energy transfer is approximately
(A) 20% (B) 25% (C) 10% (D) 2%
56. Sahara desert has been formed by
(A) Disastrous climatic conditions (B) Overgrazing of fields
(C) Uncontrolled industrialisation (D) All of these
57. Environmental planning will
(A) reduce spoilage by bacteria (B) cause more wildlife loss
(C) reduce air and water pollution (D) None of these
58. Which industrial unit is held responsible for the harm to the Taj Mahal in Area?
(A) Indian Fertiliser Company (B) Mathura Oil Refinery
(C) Madras Refineries Limited (D) Nuchem Plastics Limited
59. An example of aerosol spray is
(A) Dichloro difluoro methane (B) Tetra chloromethane
(C) Trichloro methane (D) Di-iododibromo methane.
60. The full form of DDT is
(A) Dibromo Dichloro Toluene (B) Dichloro Diphenyl Trichloroethane
(C) Difluorodichloro Terbutaline (D) None of these
61. 'Biological magnification' is related to
(A) Death of pelicans by DDT (B) Overpopulation of trees
(C) Multiplication of bacteria (D) Disposal of wastes
62. Lichens are found on hillsides under conditions where neither the alga nor the fungus can live alone. This shows that the relationship between the alga and the fungus is one of
(A) Parasitism (B) Saprophytism (C) Mutualism (D) Commensalism
63. During the period when two species occupy the same ecological niche, they are
(A) Dependent on each other (B) Competing with each other
(C) Cooperating with each other (D) Not affected by each other.
64. Conservation of the ecosystem rather than conservation of a particular species is important because
(A) Food chains and food webs are maintained (B) Different cycles operate simultaneously
(C) Abiotic and biotic factors operate at a given place (D) All of the above operate.
65. The top soil is darker and
(A) is drier than subsoil (B) is richer in Na and Mg
(C) is wetter than subsoil (D) contains more organic matter
66. Organic matter decayed to a relatively stable, amorphous state; formed when soil microorganisms decompose animal and plant material into elements usable by plants
(A) manure (B) peat (C) humus (D) green manure
67. Sheet erosion is due to
(A) fast running rivers (B) heavy rains (C) occasional rains (D) wind
68. Which is a renewable source?



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- (A) Water (B) Coal (C) Fuels (D) Minerals
- 69.** A non-renewable resource is
(A) forest (B) coal (C) water (D) wild life
- 70.** Minerals and metals are
(A) biodegradable resources (B) renewable
(C) non-renewable (D) inexhaustible
- 71.** Soil fertility is reduced by
(A) crop rotation (B) nitrogen fixing bacteria
(C) decaying organic matter (D) intensive agriculture
- 72.** Largest amount of freshwater is found in
(A) lakes and streams (B) underground (C) polar ice and glaciers (D) river
- 73.** Inexhaustible, non-conventional source of energy is
(A) solar radiations (B) wind power (C) sea tides (D) all the above
- 74.** Soil is composed of
(A) mineral + water + air (B) mineral + organic matter + air
(C) mineral + organic matter + air + water (D) organic matter + water
- 75.** Soil erosion can be prevented by
(A) restricted human activity (B) good plant cover
(C) checking movement of animals (D) wind screen alone
- 76.** The species, which are in danger of extinction, are referred to as
(A) endangered species (B) vulnerable species
(C) threatened species (D) rare species
- 77.** A biotic community consists of a union of
(A) Populations (B) Biomes (C) Ecosystems (D) Individuals
- 78.** The sum of all individuals of a given area is called
(A) Ecosystem (B) Biome (C) Population (D) Individual group
- 79.** Living and non-living species are parts of
(A) Biotic community (B) Population (C) Ecosystem (D) Atmosphere
- 80.** Pollutant from motorcar exhaust that causes mental diseases is
(A) lead (B) NO₂ (C) SO₂ (D) Hg
- 81.** Minamata disease is a pollution-related disease, which results from
(A) release of human organic waste into drinking water
(B) accumulation of arsenic into atmosphere
(C) release of industrial waste mercury into fishing water
(D) oil spills into sea
- 82.** World environment day is
(A) 5th June (B) 28th February (C) 5th August (D) 28th April
- 83.** Eutrophication leads to death of fish due to
(A) increased O₂ content (B) increased algae content
(C) decreased algae content (D) decreased O₂ content
- 84.** The two great industrial tragedies namely, MIC and Chernobyl tragedies respectively occurred where



and at which time?

- (A) Bhopal 1984, Ukraine 1990 (B) Bhopal 1984, Ukraine 1988
(C) Bhopal 1984, Ukraine 1986 (D) Bhopal 1986, Russia 1988

85. Ozone day is

- (A) January 30 (B) December 25 (C) April 21 (D) September 16

86. Formation of ozone hole is maximum over

- (A) India (B) Africa (C) Antarctica (D) Europe

87. Thermal pollution is more prevalent near

- (A) hot water springs (B) coal based power plants
(C) temperate zones (D) tropical zones

88. Acid rain is caused due to increase in concentration of

- (A) SO_2 and NO_2 (B) CO and CO_2 (C) CO and SO_3 (D) Ozone and dust

89. Ozone depletion is caused by

- (A) carbon dioxide (B) CFCs (C) CO (D) SO_2

90. Smog is a combination of

- (A) fire and water (B) smoke and fog (C) water and smoke (D) air and water

91. BOD of a pond is related to _____ in per unit volume of water

- (A) all the plants (B) all the nektons
(C) all the microbes (D) all the animals

92. NO_2 vapours are harmful to the body because

- (A) They produce allergy
(B) They produce respiratory problems
(C) They create blood clots
(D) None of these

93. Excessive contact with industrial silicon dioxide (SiO_2) would lead to the disease called

- (A) Encephalitis (B) Cretinism (C) Silicosis (D) Silaceous anaemia

94. Why is smoking injurious to health?

- (A) It can casue pregnanacy problems in smoking mothers.
(B) It can cause large scale air pollution
(C) It can be responsible for a heart attack
(D) Both (A) and (B)

95. 'Decibel' is a unit to measure

- (A) Sound depth
(B) Sound intensity
(C) Sound wavelength
(D) All of these

96. Noise pollution can be prevented by

- (A) Stopping the blowing of all horns
(B) Banning all commercial loudspeakers



- (C) Strict vigilance on noise limit
(D) Cleaning sound emitting parts of automobiles.
- 97.** An effective method to stop air pollution is
(A) Degradation of wastes causing air pollution
(B) Keeping the river water clean
(C) Keeping factories away from big cities.
(D) None of these
- 98.** The Ganga purification project is controlled by
(A) Central Water Commission
(B) Union Public Service Commission
(C) Central Pollution Control Board
(D) Central Intelligence Agency.
- 99.** Sunder Lal Bahuguna is associated with the
(A) Salt movement
(B) Green revolution
(C) Greenhouse effect
(D) Chipko movement.

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	A	A	D	C	D	A	A	B	A	C	D	A	B	C	B	A	B	B	B
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	B	A	B	B	C	B	A	B	C	C	B	D	A	A	B	A	C	B	A	B
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	C	A	A	B	D	B	D	D	B	B	B	B	D	B	C	A	C	B	A	B
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	A	C	D	D	D	C	B	A	B	C	D	C	D	C	B	A	A	C	C	A
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	
Ans.	C	A	D	C	D	C	A	A	B	B	C	B	C	D	B	C	C	C	D	



MANAGEMENT OF NATURAL RESOURCES

INTRODUCTION



The human population is increasing at a very fast rate. Growth in population takes place in geometrical progression whereas increase in food production takes place in arthmetic progression as given below:

Geometric Progression : $2 \rightarrow 4 \rightarrow 8 \rightarrow 16 \rightarrow 32$ (Population growth)

Arthmatic Progression : $2 \rightarrow 4 \rightarrow 6 \rightarrow 8 \rightarrow 10$ (Increase in fond production)

As is clear from the above figures, population grows at much faster rate than the increase in food production. As a result there is always an increase in demand for the basic requirements of man, that is, food, water, clothes and shelter. These requirements of man are fulfilled through the natural resources such as minerals, forests, groundwater, soil and through agriculture. For example, man uses wood obtained from forests as fuel as well as for construction of houses. Man uses ores obtained from the earth lithosphere for extracting metals. Coal, petroleum and natural gas are important resources of earth, which satisfy the energy requirements of man. The industrial revolution has created a greater demand for the various raw materials such as minerals, petroleum and coal than was ever required before. In order to satisfy the ever-increasing demands of food, water, clothing and shelter man has exploited the natural resources to such a greater extent that it is creating an ecological imbalance in nature.

In this chapter we will discuss about management of our natural resources like forests, wildlife, water, coal and petroleum for sustainable development. Management of the natural resources is a global problem. There are various national and international laws, regulations and acts towards protecting our environment.

	ON YOUR TIPS	
Green peace movement (international non-go-vermental organization) and chipko movement and environment society (Indian organisation) engaged in highlighting environmental issues.		

NEED OF CONSERVATION

With the coming up of advanced science and technology more and more natural resources are being used up. Old villages, hills etc., are being converted to cities. Agricultural lands are being used for constructing big hotels and industries. To generate electricity, more and more dams are being constructed. To maintain a balance between environment and development, there is a need for sustainable development. This means that present needs for development should be fulfilled in such a way that options for future generations are not closed. **To achieve this various points have to be kept in mind.**

- Ecological balance has to be maintained.
- Efficient use of resources has to be carried on.
- Planting of more trees is required.
- Conservation of various natural resource is must.
- Green patches have to be interspersed between concrete buildings.
- National parks should be established.
- Preventing air, water and land pollution.
- Proper disposal of wastes.



CONSERVATION AND JUDICIOUS USE OF NATURAL RESOURCES

Conservation is the wise and careful use of resources. It means not to control quantity of the resources but also to maintain their quality. It needs proper management of resources.

It is possible to have a cleaner, less polluted and healthier environment through proper planning. This is possible only if effective measures are taken to reduce the pollution and the various natural resources are used judiciously.

All natural resources are classified into two categories :

(A) Inexhaustible (B) Exhaustible.

(A) INEXHAUSTIBLE RESOURCES are present in unlimited quantity and do not get exhausted by human activities, e.g., solar energy, wind energy, rainfall, tidal energy, hydropower.

(B) EXHAUSTIBLE RESOURCES have limited supply on earth and are of two types:

- **Renewable resources** are those which have the capacity to reappear or replenish themselves by recycling or replacement within reasonable time, e.g., water, soil, natural vegetation, wildlife, aquatic animals.

- **Non-renewable resources** are those which lack the ability of recycling and replacement, e.g., biological species, minerals.

Renewable resources like forests and groundwater should be used only at the rate, as they are being replenished in nature. If we use renewable resources at a faster rate than they are being replenished, then it creates an imbalance and disturbs the environment adversely.

Non-renewable resources must be used as sparingly as possible so that they remain available to us for a much longer period. Coal, petroleum, natural gas and minerals are some of the important non-renewable resources. These should be used economically. Consumption of fossil fuels at a faster rate also pollutes the environment.

FACTORS TO BE CONSIDERED FOR DEVELOPMENT OF RESOURCES

- Management of resources should be done keeping in mind coming up generations. There should be equitable distribution of resources so that all get benefit from the development of these sources.

- While exploiting natural resources we cause lot of damage to the environment e.g., Mining causes lot of pollution because of lots of waste generated. There should be safe disposal of these wastes.

To overcome various environmental problems of global concern, there are national, international laws and regulations. Various national and international organisations are working towards it. e.g., Kyoto Protocol, Ganga Action Plan.

KYOTO PROTOCOL

From December 1 to 11, 1997, more than 160 nations met in Kyoto, Japan to negotiate binding limitations on greenhouse gases for the developed nations, pursuant to the objectives of the Framework Convention on Climate Change of 1992. The outcome of the meeting was the Kyoto Protocol, in which the developed nations agreed to limit their greenhouse gas emissions, relative to the levels emitted in 1990. The United States agreed to reduce emissions from 1990 levels by 7 per cent during the periods 2008 to 2012.

GANGA ACTION PLAN (GAP)

- Ganga runs its course of over 2500 kms from Gangotri in the Himalayas to Ganga Sagar in the Bay of Bengal through 29 cities with population over 1,00,000 ('class-I cities'), 23 cities with population between 50,000 and 1,00,000 ('class-II cities'), and about 48 towns. It is a river with which the people of India are attached spiritually and emotionally. Department of Environment, in December 1984 prepared an action plan for immediate reduction of pollution load on the river Ganga.

There was a need of Ganga Action Plan as quality of Ganga water reduced a lot. Ganga water had shown presence of coliform bacteria which are found in human intestine. Presence of these bacteria indicates contamination of water by disease causing bacteria.



POTABLE WATER

The dictionary definition of potable is a liquid that is suitable for drinking. People often ask themselves if their water is safe, but getting an answer isn't as simple as looking, tasting or even testing.

Some rural people use the old age-If it smells and tastes like water and looks clean like water, then it's probably okay. Although taste, odour, colour, and clarity are important, they only address water's physical aspects. The bacteriological and chemical content of water should also be tested.

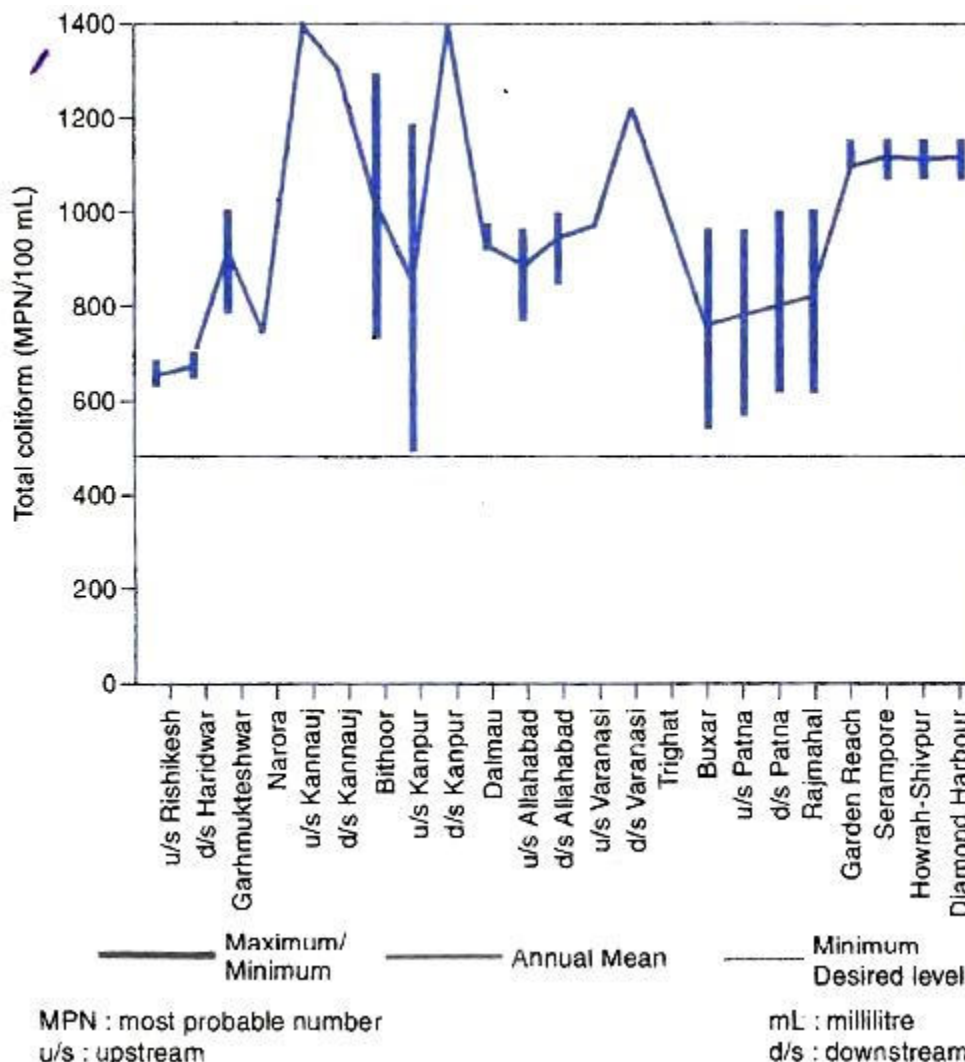


Fig.1_ Total coliform count levels in Ganga during the years 1993-94

A Little further 4.1

What would be the advantages of exploiting resources with short-term aims?

Explanation

Plant often die in water logged soil because the soil is unable to supply sufficient oxygen to roots. Under these condition root will respire anaerobically, producing

alcohol



If your water comes from a public water source such as a municipal water system, then your concern may be minimal as public water must meet, certain set criteria, before it can be used for human consumption. However, if your water is esired level your water is a private source, such as your own well or digout, then it is your responsibility to determine whether the water you drink is truly "safe" for you and your family.

Simple tests such as a bacteriological exam or a chemical analysis, only cover certain aspects of water. As well, each test may require different methods or equipment to complete the analysis. Therefore, you need to choose what tests are required. If you don't, then it's like going to buy "fluid" for your car. Unless you know exactly which one you need-washer, brake, gas, diesel-you may end up wasting your money on something you really don't need. Nor, is it easy to return a lab service.



A general chemical analysis usually covers parameters such as

- Iron
- Magnesium and Manganese
- Total Dissolved Solids (TDS)
- Fluoride
- Conductivity
- PH
- Chloride
- Turbidity
- Alkalinity
- Potassium
- Hardness
- Sodium
- Sulphate
- Nitrate and Nitrite (N)
- Calcium

	ON YOUR TIPS	
BOD is amount of oxygen required for microorganism to metabolize organic matter.		

pH MEASUREMENT

- pH measurement is the amount of alkalinity or acidity in water and water-containing fluids. For example, a pH of 1 indicates a strongly acidic solution, a pH of 7 indicates a neutral solution, and a pH of 14 indicates a strongly alkaline solution.
- pH measurement can be made using a variety of techniques and equipment ranging from simple pH test strips to sophisticated electronic test meters. .
- pH Test Strips or papers provide the means of obtaining qualitative or semi-quantitative results in seconds. They are ideal for rapid analysis or for applications that do not require highly accurate results. Simply dip the paper into the sample, remove and check for colour change.
- pH Colour Cards. With pH colour cards, a coloured water sample is compared against a card; upon which are printed coloured standards. The user simply matches the colour by eye and reads the pH level directly from the card.
- pH Test Meters. Highly accurate electronic pH test meters to assist plant engineers and managers in conducting regular, consistent and reliable testing of their water plant and systems.

PRACTICE ZONE 4.1



1. When was Ganga Action plan started?
2. What are coliform bacteria?
3. What is recycling?

USE OF THREE R'S TO SAVE ENVIRONMENT

Although there are number of problems related to environment yet we can use three 'R' formula to save it. These three R's are:

- **Reduce** Avoid waste--look for ways of producing and using goods that stop, waste being generated. Reduce waste--choose products that can be used productively, recycled in your area, and have minimal packaging.
- **Reuse** Reuse containers, packaging or waste products.
- **Recycle** Recycle waste material into useable products.
- For Waste that can't be Avoided, Reused for Recycled. Treat the waste to make it less hazardous or reduce the volume of the hazardous component. Dispose of the waste safely.



	ON YOUR TIPS	
Forth R is reforest it is the restocking of the destroyed forest by planing trees.		

REDUCE

The most effective way to help save the environment is to reduce your waste before it becomes rubbish.

- Become informed about the environmental impacts of the products you buy. If you're not satisfied, search for better alternative.
- Bulk buy when possible, but don't buy more than you can use.
- Choose products with less packaging.
- Choose products with recyclable or reusable packaging.
- Carry reusable shopping bags or boxes.
- Say 'no' to unnecessary plastic bags and other packaging.
- Reuse plastic bags and all types of containers over and over again.
- Buy quality goods that will last.
- Encourage manufacturers to play their part.

Buy Recycled Goods

Recycled goods have already saved resources and raw materials and helped reduce the overall quantity of waste. Remember, 'recycled' means the product is made partly or wholly from recycled materials and 'recyclable' means the product is capable of being recycled. If you don't make an effort to buy recycled goods, you're not really recycling.

Reduce Energy and Water Use

Reducing your waste also means saving resources. Reducing your energy consumption in the home by switching to high-efficiency fluorescent light bulbs, using cold water for washing and cooking efficiently. Large amounts of water can be saved at home by fixing leaking taps, using dual-flush toilets, running washing machines and dishwashers only when full, turning the tap off while cleaning your teeth, and using a control nozzle on your hose when washing the car or the dog. Design your garden to be water efficient.

REUSE

- Look for products in reusable, refillable or recyclable packaging when you shop.
- Donate unwanted clothing, furniture and white goods to charities.
- Enquire if goods can be repaired rather than replaced.
- Hold a garage sale.
- Use rechargeable batteries rather than single use batteries and ask your local council about how to dispose of batteries properly.
- Use retreaded tyres if they are appropriate to your driving.
- Use glass bottles and jars, plastic bags, aluminium foil and take away food containers over and over again before recycling or disposing of them.
- Carry your lunch in a reusable container rather than disposable wrapping.
- Reuse envelopes and use both sides of paper.

RECYCLE

Recycling recovers materials used in the home or in industry for further uses. You should only recycle after you've tried to reduce and reuse. Recycling has environmental, economic and social advantages.

- Recycling-generates civic pride and environmental awareness.
- Recycling helps prevent environmental pollution.



- Recycling saves natural resources.
- Recycling conserves raw materials used in industry.
- Making products from recycled ingredients often uses much less energy than producing the same product from raw materials.
- Recycling reduces the amount of material dumped in landfill sites and helps our waste disposal. Goods are used productively and prevented from becoming litter and garbage.

PRACTICE ZONE**4.1**

1. 1985
2. They are harmless bacteria present in human intestine which can indicate the degree of sewage pollution of water e.g. E.coli.
3. Recycling is the processing of waste article and materials so as to form new products.

CONSERVATION OF FORESTS AND STAKEHOLDERS

Stakeholders are :

- People living in or around forests who are fully dependent on forests for their life.
- The Forest Department of Government—owners of the land and working to control the resources from forests.
- The Industrialists using forest produce but not dependent on the forests in anyone area.
- People involved in wildlife and nature conservation. Each of the above groups depends on forests in a different way.

Local People Around Forests

- Use Bamboo to make huts.
- Use baskets for collecting and storing food materials.
- Use wood to make implements for agriculture, fishing and hunting.
- Do fishing and hunting in forests.
- Gather fruits, nuts and medicines from forests.
- Graze cattles in forests.

These people lived in forests for centuries and ensured sustainable use of resources.

The Forest Department of Government

- Later British took over most of the forest areas and exploited forests ruthlessly for their needs.
- Local people were forced to depend on smaller areas.
- Forests started becoming over exploited.
- After India became independent, Forest Department took over.
- Management practices ignored local needs and knowledge.
- Large areas were cleared and were converted to monoculture of pine, teak or eucalyptus.
- This lead to destruction of biodiversity in the area.
- Needs of local people could no longer be met from such forests.
- But these plantations worked as an important source of revenue for the forest department.
- These plantations are being used by industrialists to reveal timber, paper, lac and sports equipment.

The Industrialists

- Forests provide raw material for various industries.
- Industrialists have access to these raw materials at artificially low rates.
- Industries have greater reach than local people.
- Industrialists are not interested in sustainability of forests.
- After cutting teak trees in one area, they shift to another.
- They do not ensure that one particular area should yield optimum amount of some produce for all coming up generations.



Nature and Wildlife Enthusiatics

- They are not at all dependent on the forests.
- They have realized the need to preserve biodiversity.
- For example, Bishnoi Community in Rajasthan take forest and wildlife conservation as a religious tenet.
- Amrita Devi Bishnoi, National Award for Wildlife Conservation has been instituted recently in the memory of Amrita Devi Bishnoi who sacrificed her life alongwith 363 others in 1731 for protection of 'Khejri' trees in Khejrali Village near Jodhpur in Rajasthan.

From above discussion, we can reach to the conclusion that by keeping local people out and using forests cannot prove to be successful in the long run. Forest have to be used sensibly keeping both environment and development sound.

A Little further 4.2

How would these advantages differ from the advantages of using a long term perspective in managing our resources?

Explanation

Exploiting resources with short-term aim are beneficial for the present generation to meet current basic human needs while using with a long-term prespective aims to fulfil the need of future generation. A long-term perspective in managing our resources is a sustainable practice that enables the present generation to use natural resources judiciously so dial their availability is ensured for the future generations too.

FORESTS AND ITS CONSERVATION

Forests are one of the important natural renewable natural resource which is mainly composed of trees, shrubs or any other woody vegetation. About one third of total land is under forest cover. They are the store house of biodiversity (bacteria, fungi, ferns, flowering plants, nematodes, insects, birds, reptiles, etc.) and provide various services to mankind. Now, if trees are cut at the rate which exceeds their rate of replenishment, it disturbs the environment. It may lead to formation of deserts.

In the ancient times, many parts of the earth had lush green forests. In 'order to meet the requirements of increasing population, the trees have been cut senselessly. Trees provide wood for fuel and as well as furniture and for building houses. Forests have also been cut to clear land for cultivation and for building house. Many industries such as paper industry, match industry depend upon forest wood.

Forests play a major role in soil conservation and in maintaining the water cycle in nature.

1. Roots of trees keep the topsoil bound and prevent it from being washed away through water erosion as well as through wind erosion.
2. Forests are also natural habitat of wild animals and birds.
3. Trees give on large amounts of water by the process of transpiration. This helps in formation of rain clouds and bringing fresh water to the earth.
4. Forests help in maintaining oxygen and carbon dioxide levels.
5. They also play important role in regulating the earth's temperature;
6. Forests also act as saviour from various solar radiation;
7. Forests provide raw material for paper industry.
8. Forests have various protective functions like prevention of draught, protection against wind, cold, noise, radiations and even conservation of soil and water.
9. Forests are important for production of timber, bamboos, food" and wide variety of compounds like resins, alkaloids, essential oils, latex and various pharmaceutical products.
10. Forests regulate amourit of CO₂ and O₂, water, minerals, radiant energy, draughts, various geochemical cycles, atmospheric and temperature conditions and thus increaseenvirorunental values of the area.
11. Forests help in reducing atmospheric pollution by checking SPM.

Destruction of forests for human leeds disturbs the ecological balance. Various causes which are leading to cutting of more and more trees or deforestation are :



- Explosion of human population, leading to increased demand of timber, fuel, paper, wood, etc.
- Forest fires.
- Overgrazing.
- Forest storms, frost and heat also lead to deforestation.
- Some insects and pests also destroy trees by eating up leaves and by spreading various diseases.
- Large areas have been cleared for agriculture, housing, factories, roads and railway tracks.
- Construction of roads along mountains is another cause of forest degradation.
- Mining has also contributed in the large scale felling of trees.
- Construction of dams and reservoirs.



PRACTICE ZONE

4.2

1. What is conservation?
2. Name the stakeholders in forest.

Consequences of Depletion of Forests

1. Due to depletion of forests, rainfall in the region decreases and area may finally become a desert.
2. Deforestation may also lead to frequent floods in the area.
3. It destroys the natural habitat of wild animals and birds.
4. It leads to topsoil erosion.
5. It reduces soil fertility.
6. Forests specially on mountains protect protection from floods by trapping and absorbing water and then slowly releasing it.
7. Deforestation causes extinction of various species resulting into a loss of irreplaceable resources.
8. It also brings about regional and global climate changes which become warmer because of lack of humidity.
9. It deprive human beings of the benefits of forest trees and animals.
10. It threatens tribal people whose survival mainly depends on forests.

	ON YOUR TIPS	
The forests cover in the country estimated 19.44% but according to National forest policy it should be 30%		

Conservation of Forests

Man can play an active role for the replenishment of forests.

1. Silviculture is one of the major programmes started to replenish forests. Some of the benefits achieved through this programme are :
 - It has helped in preserving the environment by bringing more and more area under forests .
 - It produces large quantities of raw materials for various industries.
2. Afforestation should be there in the areas which are unfit for agriculture, along highways and rivers.
3. Awareness programmes should be there. A special programme of tree plantation called Van Mahotsava is held every year in our country. It should be made more popular.
4. Pests and diseases can be controlled by using pesticides, fumigation and biological control method.
5. Grazing by cattle should be discouraged.



6. Forests should be protected from fire. Latest fire fighting equipment should be used to extinguish accidental forest fire. .
7. Economize the use of timber, fuel, wood etc.
8. We must find out alternate sources of fuel, e.g., solar energy.

IMPORTANCE AND CONSERVATION OF WILDLIFE

Wildlife is of great importance to us. Wildlife includes all animals which are not domesticated, tamed and plants which are not cultivated. Importance of wildlife is being discussed here as under:

- It forms links in the food chain.
- It plays important role in formation and protection of soil.
- It helps in natural recycling of materials.
- It helps in maintaining gaseous composition of atmosphere.
- It is a source of livelihood for many people.
- It has aesthetic and cultural benefits as it provides good deal of fun and recreation e.g., Bird watching, Pet keeping etc.
- Many improved varieties of crops are developed through breeding programmes. Genes of wild species are used to have better breeds.
- There may be some unknown benefits. It is unpredictable that which species become useful in future, e.g., Penicillium and Cinchona.

PRACTICE ZONE 4.2

1. Conservation is protection and scientific management of a resource so as to maintain it is at optimum level for providing benefits to present as well as future generation.
2. Stakeholders connected with forest are local resident to next department, industrialists and wildlife, nature enthusiasts.

CONSERVATION

Large scale poaching by man poses a serious threat to the survival of many species of wildlife, both plants as well as animals. This can disrupt the food chains in which these animals occur. Thus, it is very important to conserve wildlife. Some of the remedial measures then can be taken for the conservation of wildlife are below:

1. Natural habitat of the animals should be preserved. This can be achieved through increasing the area under forests and also through establishing large number of wildlife sanctuaries and national parks. Unauthorized felling of trees should be curbed as it destroys the habitat of animals. For every acre of forest cut down an equal area should be planted with saplings. Some of the National Parks and Bird Sanctuaries developed in our country are :
 - Gir National Park in Gujarat
 - Corbett National Park in Uttar Pradesh
 - Shivpuri National Park in Madhya Pradesh
 - Kanheri National Park III Maharashtra
 - Bharatpur Bird Sanctuary in Rajasthan.
2. The number of wild animals should be regularly monitored in the wildlife sanctuaries. Special attention should be paid to the endangered species.
3. Poaching should be totally banned. Rules should be framed so that poaching or killing of endangered species becomes a punishable offence under law.
4. Species going towards extinction should be given importance over other conservation programmes.
5. Protection of ecosystems can help in protection of species.
6. Biosphere reserves deal with the conservation of ecosystems and the genetic resources contained therein. The biosphere reserves are a special category of protected area of land/or coastal environments wherein people are an integral component of the system.
7. Besides insitu conservation (conservation in natural habitats), exsitu conservation (i.e., conservation away from natural habitats) can also help, e.g., Botanical gardens, Zoological gardens, Aquaria, Seed banks, Gene banks.



8. Various wildlife projects have been started to its conservation, e.g.,
 - Project tiger in 1973 to check reduction in the population of tiger.
 - Elephant project started in 1992.
9. There should be proper survey of all forests to have approx. number of species in a specific area.
10. There should be protection of habitats, food and shelter of endangered species.



A Little further 4.2

Suggest some approaches towards the conservation of forests.

Explanation

The following measures are suggested for the conservation of forests :

- (i) Plantation of indigenous species to develop forests in all the available land,
- (ii) Indiscriminate felling of trees for the purpose of timber must be reduced,

	ON YOUR TIPS	
Government of India has constituted " Amrita Devi Bishnoi National award for wildlife conservation in memory of the incident		

CHIPKO MOVEMENT

Chipko movement i.e., "Hug the Trees Movement" is one of the movements in India to conserve biodiversity and to end the alienation of people from their forests which started in March, 1973. **Sunderlal Bahuguna of Tehri** and **Chandi Prasad Bhatt of Gopeshwar** are prominent leaders of this movement. It was Sunderlal Bahuguna who was able to transfer ecological perspective to Chipko. Main objectives of chipko movement are :

- To protect existing forest cover.
- Afforestation.
- To utilize forest wealth keeping in mind its conservation.
- Leaders of chipko movement believes in food, fodder; fuel, -fertilizers and fibres.
- Forests are must to protect environment and maintain ecological balance and should not be disturbed.

A movement similar to chipko was started by Pandurang Hedge in South. It is known as Appiko movement which believes in conservation, plantation and rational use. As a result of chipko-movement :

- Private contract system of felling trees was abolished.
- Commercial green felling in the Himalayan forests of Uttar Pradesh were banned.
- Felling of trees was stopped in the Western Ghats and the Vindhyas.

These movements originated in early 1970 in a remote village called Reni in Garhwal, high up in Himalayas. When local villagers stopped felling of trees by a logging contractor. Women of the village clasped the tree trunks while men folk were absent. This prevented workers from felling the trees and inwared contractor had to withdraw. Slowly with the spreading of these movements, people learnt priorities in the use of forest produce.

In 1912, West Bengal Forest Department recognised its failures in the revival of the degraded sal forests in southwestern districts of the state. This had led to attention of people by the administration. Result was clash between forest officials and villagers. These conflicts were major factor in fuelling the militant peasant movements led by the Naxalities.



Later the Department changed its strategy. In the Arbari forest range of Midnapore district, far seeing forest officer A.K Banerjee and villager got involved in the protection of 1,272 hectares of badly degraded sal forest.

- Villager were given employment in the programme of, replenishment of forests i.e., Silviculture and harvesting operations.



- 25 percent of the final harvest.
- Allowed fuel wood and fodder collection on payment of nominal fee.

As a result of active participation of people mainly the local community, the sal forests of Arabari underwent a remarkable recovery by the year 1983.

	ON YOUR TIPS	
Water conservation and management relate to three main sources of water. <ul style="list-style-type: none"> • Surface water • Ground water • Rain water 		

WATER FOR ALL

Kulhs in Himachal Pradesh

- Kulhs is a local system of canal irrigation which evolved about four hundred years ago in parts of Himachal Pradesh.
- Water from streams was diverted to man-made channels.
- Those channels took water to many villages down the hill side.
- There used to be common agreement between all the villages to manage the flowing water in Kulhs.
- Village which was farthest was the first one to use water during planting season.
- Then water was used up by villages progressively higher up.
- Kulhs were managed by two or three people. They were paid by the villagers.
- Besides above, water also percolated into the soil and fed springs at various points.
- Later Kulhs were taken over by irrigation department which stepped sharing of water as before.

Rains in India are in a few months of the year. Failure to sustain underground water availability occurs as a result of :

- Loss of vegetation cover
- Diversion for high water demanding crops
- Pollution from industrial effluents and urban wastes.

To meet agricultural and daily needs of water throughout the year various dams, tanks and canals were used. Maintenance of irrigation systems etc., was a local affair. Arrival of British led to, up coming of large dams which neglected local irrigation methods.

A Little further 4.4
Compare the above system with the probable systems in hilly/mountainous areas or plains or plateau regions.
Explanation
Water harvesting system in the hilly areas are quite different from those of plain areas. In all Himachal Pradesh, had evolved the local system of canal irrigation called kulhs over four hundred years ago. The water flowing in the streams was diverted into man-made channels which took this water to numerous villages down the hillside. The management between all the villages. Interestingly, during the planting season, water was first used by the village farthest away from the source of the kulh, then by villages progressively higher up. These kulhs were managed by two or three people who were paid by the villagers. In addition to irrigation, water from these Kulhs also percolated into the soil and fed springs at various points.



DAMS

A **dam** is a barrier built across a stream or river to hold and control the flow of water for useful purposes. There are several types of dams. The choice of dam is decided upon by examining foundation conditions, load strains, temperature and pressure changes, chemical characteristics of groundwater and possible seismic activity.

Historically, dams and the lakes have protected growing populations from the unpredictability and violence of rivers seasons. In some regions, stored flood waters can supply enough irrigation for a year-round growing season.

Dams have been built with the intention to improve human quality of life by diverting water for power, navigation, and flood control, but have also resulted in human health concerns and environmental problems. Dams benefit people by providing usable, reliable water sources.

Although there are numerable benefits of dams but construction of dams bring about lot of changes in the regional environment. It leads to ecological imbalance. Its impact at times is so much that changes cannot be reverted back. So it is very important to think about various alternatives to dams.

DAMS : ADVANTAGES AND LIMITATIONS

The main purpose of dams is to improve human quality of life by providing drinking water and to support economic growth by diverting water for power, navigation, flood control and irrigation. Dams have succeeded for the same in various ways. Various advantages of dams are:

- Provides supply of water for towns, cities and mining sites .
- Provides supply of water for irrigation of crops.
- Controls floods.
- Contains and stores wastes (tailings) from mines.
- Creates lakes for people to swim in and sail on and thus provides recreational opportunities.
- Generates electricity in hydroelectric power stations.
- Navigation.
- Provides greater habitat diversity.
- Controls the flow of water.

Although dams are multipurpose and beneficial for humans but they have some adverse effects also, as they disrupt ecosystems, decline fish stocks, force resettlements etc.

Dams change the chemical, physical and biological processes of river ecosystems as they alter free-flowing systems by reducing river levels, thereby **blocking the flow of nutrients, changing water temperature and oxygen levels and preventing fish and wildlife migration**. These changes may be beneficial or tragic.

Some of the disadvantages of dams are :

- Dams lead to alterations in temperature and flow in the river downstream from the dam.
- Loss of flowing water habitat and replacement with standing water (reservoir) habitat.
- Interruption of animal movements along the course of the river.
- Interruption of genetic exchange among populations inhabiting the river course.
- Alteration of the fish community in the region of the river now inundated and upstream from the reservoir.
- Reduction in the delivery of river nutrients to downstream section of the river because of entrapment by the reservoir.
- Dams detract from natural settings, ruin nature's work.
- Dams inundate the spawning grounds of fish.
- Dams inhibit the seasonal migration of fish.
- Dams threaten and endanger some species of fish and mussels.
- Dams inundate various archaeological sites.
- Reservoirs can foster diseases if not maintained significantly.
- Reservoir water can evaporate significantly .
- Some scientists believe that reservoirs can cause earthquakes.
- Reservoir created by dam may inundate land resulting in the loss of crops, and cities.



- People are displaced by the reservoir and have to find new homes.
- Reservoir cause instability of hill slides.
- Submerge places of green cultural and spiritual importance.
- Cause earthquakes because of the weight of water in reservoirs.
- Destroys marine fisheries because they disrupt river borne flows of fresh water and nutrient into oceans.
- Leads to coastal erosion .
- Occasionally collapse and drown people. In the world's worst dam disaster-a mega-catastrophe that struck China in 1975 when two large dams burst-as many as 2,30,000 people died.
- Induce seismicity in previously a seismic regions.
- Affects groundwater levels as seepage and evaporation from big lakes is significant.

PRACTICE ZONE 4.3



1. Name two traditional water harvesting system.
2. Give one criticism about large dams.
3. What is the impact of excessive irrigation and intensification of agriculture?

THE EFFECTS OF UNPLANNED TECHNOLOGICAL GROWTH

Before starting any technological project, it is very important to consider the long term effects of the project on the environment. The unplanned technological growth in any area may disturb the delicate balance existing in the ecosystem.

Few examples of unplanned technologies and mismanagement are :

- Indira Gandhi Canal brought greenry to many areas of Rajasthan but inequitable distribution of water created problems. People closer to the source grow crops like sugarcane and rice which need lot of water. As a result, people downstream do not get any water.
- Lot of problems are counting up as a result of raising the height of the Sardar Sarovar Dam be on the river Narmada. This has started with the protests by the Narmada Bachao Andolan (save the Narmada Movement).

	ON YOUR TIPS	
In India, Tawa irrigation project (1970) in Madhya Pradesh has resulted in problems of water logging and increased salinity		

From the above instances, the importance of foresight and long term planning, before starting any project that interferes with nature, should become clear.

Above discussion explains how poor tribal people gets affected from various development projects and three main problems arising as a result of large dams are :

1. Social problems as it displaces large number of people without adequate rehabilitation.
2. Economic problems as lot of public money is utilized without proper benefits.
3. Environmental problems as it leads to deforestation and loss of biodiversity.

PRACTICE ZONE 4.3

1. Kulh, Khadin
 2. Large dams consume large amount of public money without the generation of proportionate benefits.
 3. It has resulted in environmental degradation and creastion of few waste lands.
- Water logging has ultimately caused development of saline soil.



WORLD COMMISSION ON DAMS

In response to the growing opposition to large dams, the World Commission on Dams (WCD) was established by the World Bank and IUCN in 1998.

The Commission's mandate was to :

- review the development effectiveness of large dams and assess alternatives for water resources and energy development; and
- develop internationally acceptable criteria, guidelines and standards for the planning, design, appraisal, construction, operation, monitoring and decommissioning of dams.

The **12 Commissioners** came from a variety of backgrounds, representing a broad spectrum of interests in large dams including governments and non-governmental organisations, dam operators and grass roots people's movements, corporations and academics, industry associations and consultants. Commission's final report was released in November 2000.

ALTERNATIVES TO DAMS

When a proposal to build a new dam is put forward two types of studies are usually carried out:

- Firstly, the cost/benefit ratio of the dam project is calculated, i.e., does the value of the benefits that will be obtained by building the dam exceed the cost of building the dam? This study is intended to determine if the building of the dam is economically justified.
- Secondly, the effect of the new dam on the environment is assessed in an Environmental Impact Statement (EIS).

One question usually asked is; "Is a new dam really needed or could the objectives of the dam project be achieved in some way other than by building a new dam?" The answer to this question depends on what the objectives of the dam project are e.g., if the dam is to be built to meet the **additional demand for water supply** to a growing city it might be possible to meet this demand by obtaining water from another source, e.g., groundwater pumped from underground aquifers, or the demand for water might be reduced by, for instance, increasing the cost of water to the consumer. In either case, it might be decided that the construction of a new dam is not required after all.

In the case of a dam which is to be built to generate electricity it might be similarly possible. to reduce demand by increasing cost or the electricity might be able to be generated in some other way, e.g., solar, coal fire or nuclear power stations. Obviously many factors, both economic and environmental, have to be considered before it can be decided, for example, whether a new dam or a new coal fire power station is more desirable.

Dams do create some adverse environmental impacts and some high profile, large dam projects in the past are now thought by some to have caused unacceptable environmental damage. The **environmental problems** associated with dams can be successfully managed in the dam designing process so that they are less damaging to the environment.

There are many different alternatives to dams depending on the purpose of the dam.

1. AGRICULTURE, IRRIGATION AND WATER SUPPLY

Various alternatives to new storage dams that produce same amount of agricultural products using less water are :

- Improved management of surface irrigation systems e.g., downstream control systems, channel maintenance.
- Selection of better field application practices e.g., 'bed and furrow' irrigation, or drip irrigation instead of flood irrigation.
- Encouraging a cropping pattern that is adjusted to the local climatic conditions e.g., growing sorghum instead of rice or wheat in drought prone areas.
- Enhancing local water storage in pond or lakes through small structures, connecting channels and measures to encourage groundwater recharge, such as the traditional 'tank' system in Southern India.
- Adopting water harvesting techniques can provide an alternative to large reservoirs, or reduce the volume of new storage required. In this chapter we will be discussing about this alternative way of dams.

Like agriculture various savings can be made in industry and domestic water use.



- Leakage reduction programmes, which stabilise and reduce losses from piped systems.
- Rainwater harvesting through rooftops, tanks and other methods.
- Infiltration techniques to maintain groundwater levels in areas that have short but intensive rainy seasons.
- Reuse and recycling of water.
- Desalinisation, although current techniques are both expensive and energy intensive.

2. ENERGY

In case objective of the dam is to meet additional demand of energy like water supply, hydroelectricity then other alternatives to dams can be thought of. Use of renewable energy like solar energy, wind energy, ocean energy and biomass which are always available and non-polluting can prove to be useful. This can prevent large scale damage of environment.

3. FLOOD MANAGEMENT

Various alternatives to dam construction for flood control are always there.

- Reducing the scale of floods through better catchment management, controlling run-off, and protection of wetlands.
- Isolation of flood threat by flood embankments, flood proofing and limiting flood-plain development.
- Increasing people's coping capacity with emergency planning, forecasting, warnings, evacuation, compensation and insurance.

A Little further 4.5

Find out the source of water in your region/locality. Is water from this source available to all people living in that area?

Explanation

The sources of water in my locality are ground water through hand pump and the municipality supply. Sometimes, especially in summer season, water from these sources becomes scant. In my locality, water is available to all the people.

WATER HARVESTING

Water is essential to all life forms on earth. Therefore adequate supplies of water have to be there to sustain such life. Development of water supplies should be undertaken so as to preserve the hydrological balance and the biological functions of our ecosystems.

Consequently, the human endeavour in the development of water sources must be within the capacity of nature to replenish and to sustain. If this is not taken care, it can lead to serious consequences. The application of innovative technologies and improvement of indigenous ones should therefore include management of the water sources to ensure sustainability and to safeguard the sources against pollution.

Lot of work is being done by various organisations to rejuvenate ancient systems of water shed management as an **alternative to mega projects like dams**.

Main aim of water shed management is to develop primary resources of land and water without disturbing ecological imbalance. Water shed management :

- Increases the production and income of water shed community.
- Migrates droughts and floods.
- Increases the life of the downstream dam and reservoirs.

Various indigenous water saving methods were used by communities as they:

- dug small pits and lakes.
- put in place simple water shed systems.
- built small earthen dams.
- constructed dykes, sand and limestone reservoirs.
- set up rooftop water collecting units.

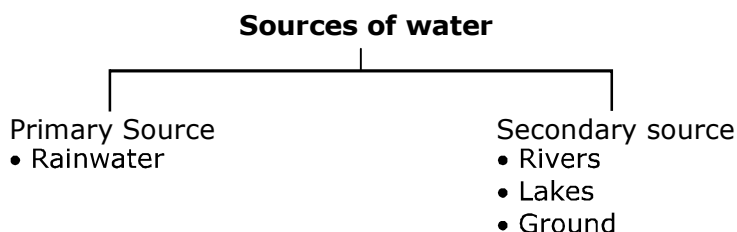
All these methods helped in recharging groundwater levels.



Water harvesting is very old concept in India. Some of the ways of water harvesting in different areas of India are :

1. Rajasthan-Khadins, tanks and nadis.
2. Maharashtra-Bandharas and tals.
3. Madhya Pradesh and Uttar Pradesh-Bundhis.
4. Jammu-Ponds in the Kandi belt.
5. Tamil Nadu-Eris or tanks.
6. Kerala-Surangams.
7. Karnataka-Hattas.

Rain Water harvesting is the activity of direct collection of rainwater, which can be stored for direct use or can be recharged into the groundwater. Water harvesting is the collection of run off-for productive purposes.



Since the ultimate source of water that feeds all secondary sources is rain, therefore we need to understand the value of rain and make optimum use of rainwater at the place where it falls.

NEED FOR RAIN WATER HARVESTING

- Water is becoming scarce day by day. Therefore, there is need to attain self-sufficiency to fulfil water needs.
- Groundwater is getting depleted and polluted.
- A urban water supply system is under tremendous pressure for supplying water to ever increasing population.
- Soil erosion resulting from unchecked run-off.
- Health hazards due to consumption of polluted water.

METHODS OF WATER HARVESTING

- Rainwater stored for direct use in above ground or overhead tanks and used directly for various purposes.
- Recharged to ground through recharge pits, dug wells, bore wells, soak pits, recharge trenches etc. This is called groundwater recharge.

BENEFITS OF WATER HARVESTING

Water is a scarce natural resource in most regions of India. Water has to be piped over long distances from perennial sources to urban areas where efficiencies are low. Collection, storage and efficient use of rainwater can reduce the cost of public water supply.

There are number of benefits of harvesting water.

- Provides self-sufficiency to water supply.
- Conserves valuable groundwater and reduces monthly water bill.
- Reduces the cost for pumping of groundwater.
- Reduces local flooding and drainage problems.
- Provides high quality water, soft and low in minerals.
- Flushes salt build up from soils.
- Reduces soil erosion.
- Decreases landscaping and property maintenance needs.
- Supplements water requirement during summers and drought.



- Provide excellent quality water for homes.
- Saves money and energy.
- Provides control over water source.
- Contributes to ecological cause.
- Reduces groundwater pollution.
- Rainwater harvesting systems are simple and can be adopted by individuals.
- In hilly terrains, rainwater is preferred.
- In coastal or saline areas, harvesting of rainwater provides good quality water and when recharged to groundwater, reduces its salinity and also helps in maintaining balance between the fresh-saline water.
- In deserts, where rainfall is low, rainwater harvesting is very useful. Advantages of Rain Harvesting over Mega Irrigation Projects
- It is a potential solution to problems of rural poverty and unemployment, resulting in an overall improvement in the nation's economy.,
- It gives high agricultural returns.
- It is sustainable due to decentralisation and community participation.
- Its installation and maintenance are cost and time effective.

On the contrary, Mega Irrigation Projects initiated during and after independence have the following disadvantages :

- They are capital intensive.
- They have long gestation periods.
- They give low agricultural returns.
- They face problems of silting.

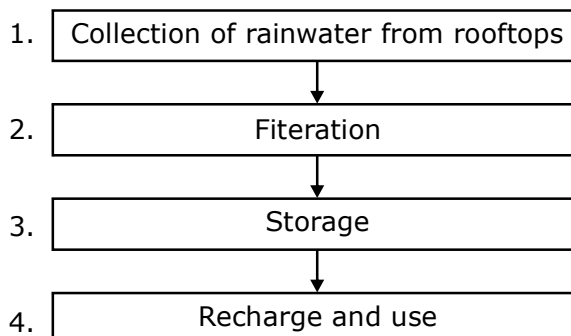
COMPONENTS OF WATER HARVESTING

Water harvesting is mainly of two types :

(A) Rainwater Harvesting. (B) Surface run-off harvesting.



Harvesting system has following components.

- Water collection from rooftops/open surface.
- Filtration in case of surface run-off harvesting.
- Storage in tanks.
- Distribution.
- Recharge the subsurface aquifers.
- System maintenance.



Steps of roof top rainwater harvesting



	ON YOUR TIPS	
Catchment area is the area from which rainfall flow into a reservoir river system		

(A) RAINWATER HARVESTING

1. RAINWATER COLLECTION

Rainwater can be captured from any rooftop. Collection efficiency depends on the size of catchment area, amount of rainfall and the design. Collected water is drained to the collection vessel through downpipes into the storage system.

2. STORAGE

Storage systems can vary in complexity on your needs. Storage may be in groundwater reservoir or tanks. A more involved systems include timed watering systems. Before storing water it should be made free from debris and leaves by placing screens over gutters (filtration). Water kept in tanks should be covered to minimize algal growth and eliminate the potential for mosquito breeding.

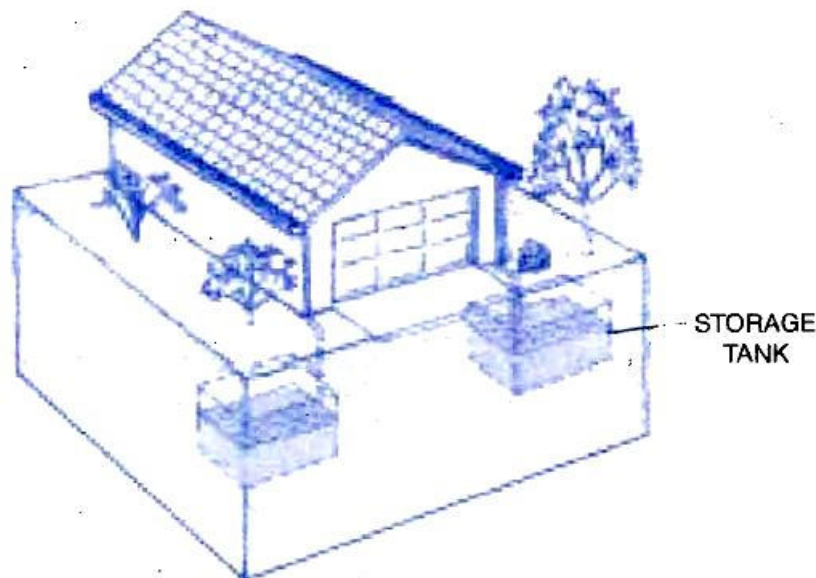


Fig. 2_Rainwater collection and storage

Storage in Groundwater Reservoir

- For rooftop rainwater harvesting through tubewells and handpumps, filter or desilting pit should be provided so that there is no silting of wells.
- Such tubewells if pumped intermittently, increase the efficiency of recharge.
- If groundwater reservoir is recharged through shaft, dug well etc., inverted filter may be provided.

Storage in Tanks

- A storage tank should not be located close to a source of contamination, such as a septic tank etc.
- A storage tank must be located on a lower level than the roof to ensure that it fills completely.
- A rainwater system must include installation of an overflow pipe which empties into a nonflooding area. Excess water may also be used for recharging the aquifer through dug well or abandoned handpump or tubewell etc.
- A speed breaker plate must be provided below inlet pipe in the filter so as not to disturb the filtering material.
- Storage tanks should be accessible for cleaning.

The inlet into the Storage tank should be screened in such a way that these can be cleaned regularly.

- Water may be disinfected regularly before using for drinking purpose by chlorination or boiling etc.

- **Rainfall water containers.** As an alternative to storage tanks, battery tanks (i.e., interconnected tanks) made of pottery, ferrocement, or polyethylene may be suitable. The polyethylene tanks are compact but have a large storage capacity (1000 to 2000 litre) are easy to clean and have many openings which can be fitted with fittings for connecting pipes.

3. DISTRIBUTION

Water stored can be distributed through regular drip irrigation system. Gutters or down spouts can be designed to catch rainwater and distribute directly to landscape plants. Even rainwater can be directed to rock lined trenches or perforated pipes and allowed to infiltrate into the soil.

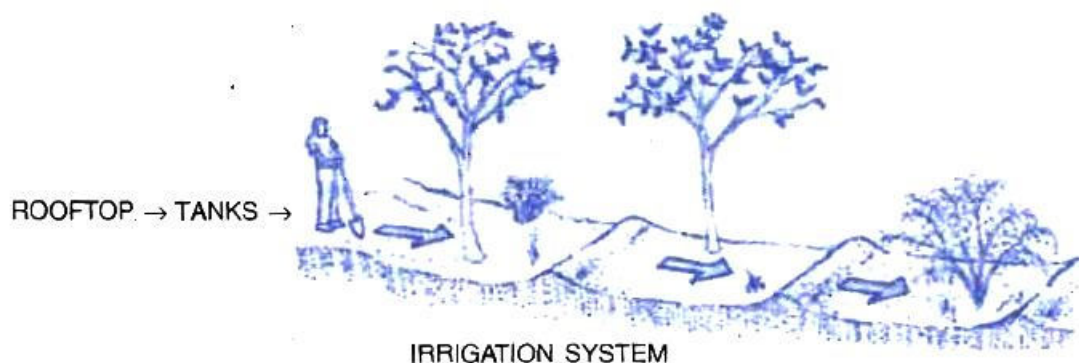


Fig.3_Distribution of harvested water

4. SYSTEM MAINTENANCE

Water harvesting systems need to be maintained regularly. Debris screen over gutters should be cleaned and storage tanks should be drained and cleaned periodically.

(B) SURFACE RUN-OFF HARVESTING

Rainwater harvesting using ground or land surface catchment areas is less complex way of collecting rainwater. It involves improving run-off capacity of the land surface through various techniques including collection or run-off with drain pipes and storage of collected water. Compared to rooftop catchment techniques, ground catchment techniques provide more opportunity for collecting water from a larger surface area. By retaining the flows (including flood flows) of small creeks and streams in small storage reservoirs (on surface or underground) created by low cost (e.g., earthen dams), this technology can meet water demands during dry periods. There is a possibility of high rates of water loss due to infiltration into the ground, and because of the of ten marginal quality of the water collected, this technique is mainly suitable for storing water for agricultural purposes. Various techniques available for increasing the run-off within ground catchment areas involve.

- **Clearing or altering vegetation cover.** Clearing vegetation from the ground can increase surface run-off but also can induce more soil erosion. Use of dense vegetation cover such as grass is usually suggested as it helps to both maintain an high rate of run-off and minimize soil erosion.
- **Increasing slope.** Steeper slopes can allow rapid run-off of rainfall to the collector. However, the rate of run-off has to be controlled to minimise soil erosion from the catchment field. Use ecr of plastic sheets, asphalt or tiles alongwith slope can further increase efficiency by reducing both evaporative losses and soil erosion. The use of flat sheets of galvanized iron with timber frames to prevent corrosion was recommended and constructed in the State ofVictoria, Australia, about 65 years ago.
- **Soil compaction by physical means.** This involves smoothing and compacting of soil surface using equipment such as graders and rollers. To increase the surface run-off and minimize soil erosion rates, conservation bench terraces are constructed along a slope perpendicular to runoff flow. The bench terraces are separated by the sloping collectors and provision is made for distributing the run-off evenly across the field strips as sheet flow. Excess flows are routed to a lower collector and stored.
- **Soil compaction by chemical treatments.** In addition to clearing, shaping and compacting a catchment area, chemical applications with such soil treatments as sodium can significantly reduce the soil permeability. Use of aqueous solutions of a silicone (water repellent) is another technique for enhancing soil compaction technologies. Though soil penneability can be reduced through chemical treatments, soil compaction can induce greater rates of soil erosion and may be expensive. Use of sodium-based chemicals may increase the salt content in the collected water, which may not be

suitable both for drinking and irrigation purposes. The water harvesting structures in level terrain are crescent shaped earthen embankments (low) and straight concrete and rubble check dams built across seasonally flooded gullies. Large structures provide water an the year round but smaller ones dry up after six months of monsoons. Water stored in dug wells is therefore more advantageous as it does not evaporate and also does not provide breeding grounds for mosquitoes. Groundwater is also protected from all kinds of contamination.

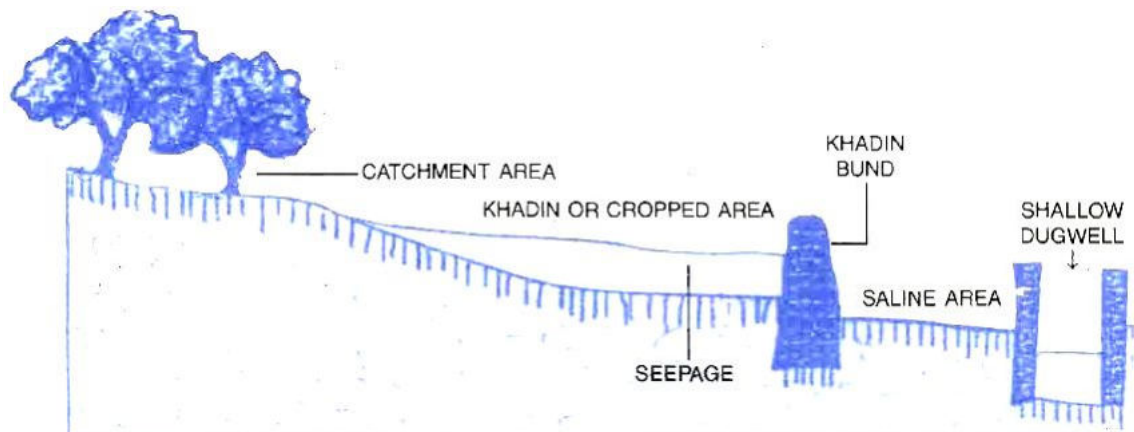


Fig.4_Traditional (Khadin) water harvesting system

Disadvantage of Rainwater Harvesting

Disadvantages of rainwater harvesting technologies are mainly due to the limited supply and uncertainty of rainfall. Adoption of this technology requires a bottom up approach rather than the more usual 'top down' approach employed in other water resources development projects. This may make rainwater harvesting less attractive to some governmental agencies tasked with providing water supplies in developing countries, but the mobilization of local government and NGO resources can serve the same basic role in the development of rainwater-based schemes as water resources development agencies in the larger, more traditional public water supply schemes.

FOSSIL FUELS

Major part of our energy needs is being supplied by fossil fuels : coal, petroleum and natural gas. Fossil fuels are the carbon containing substances that were formed from the remains of the organisms (plants and animals) that lived millions of years ago and were buried deep in the interior of the earth. Under the influence of high temperature and pressure and the absence of oxygen, these plant and animal remains were converted into fossil fuels. Large plants were converted into coal whereas small plants and animals were converted into petroleum and natural gas.

Fossil fuels are energy rich molecules of carbon compounds which were originally made by plants with the help of solar energy. When fossil fuels are burnt, chemical energy stored in them long ago, from sunlight via photosynthesis is released. All fossil fuels yield CO_2 and H_2O as the products, on complete combustion.

Fossil fuels are depletable or non-renewable sources of energy. They are being consumed at a rate much faster than the rate of their formation. So, they should be used with care and caution as these cannot be regenerated at the place of extraction.

COAL AND ITS CONSERVATION

Coal is naturally occurring black mineral which is a mixture of free carbon and compounds of carbon containing carbon, hydrogen, oxygen, nitrogen and sulphur. It is not only a good fuel but is also a source of many organic compounds. Coal is believed to be formed from fossils which got buried inside the earth during earthquakes and volcanoes which occurred about 300 million years ago. Today we get coal from these ancient deposits. Movable coal is defined as 50 per cent of all coal which is in a seam of at least 12 inches thick and within 4000 feet at the surface. In India, coal is found mainly in Bihar, Orissa, Madhya Pradesh and West Bengal.



USES OF COAL

- It is used as a fuel.
- It is used in the manufacture of coke.
- It is used in producing energy in thermal plants.
- It is used in manufacture of synthetic petrol and synthetic natural gas.
- It is used in manufacture of industrial fuel gases such as water gas.
- It is a source of large number of organic aromatic compounds such as benzene, toluene, xylene, phenol etc.

CONSERVATION OF COAL

1. Alternative sources of energy can be used e.g., Biogas.
2. Thermal power plants use coal which produce lot of CO₂, CO, SO₂ and nitrogen oxides. Therefore, some non-conventional sources can be thought of e.g., solar energy.
3. Searching newer areas having fossil fuels.
4. Protecting coal mines from accidental fires.
5. Developing better techniques to extract fuel from depleting resources.
6. Reducing wastage.
7. Increase in generation of hydroelectric energy.
8. Tidal waves of sea can be used to turn turbine and generate electricity.
9. Use of biomass energy. This term is used for all materials originating from photosynthesis which includes live plant material, fresh and marine algae, agricultural and forest residues like, straw, bark, sawdust, husks, roots, animals wastes.
10. Geo-thermal energy. In some places heated water comes out as hot springs. It can be used for heating water and buildings and for generating electricity.

PETROLEUM AND ITS CONSERVATION

Petroleum is also called rock oil (petra = rock, oleum = oil). It is a dark coloured liquid which occurs at various depths below the surface of the earth. The oil derived from oil wells is generally called mineral oil or crude oil. Petroleum is essentially a mixture of hydrocarbons mainly alkanes, cycloalkanes and aromatic hydrocarbons. Apart from hydrocarbons it may also contain compounds containing oxygen and nitrogen. The exact composition of crude oil varies from one place to another and also from one field to another.

According to modern view, the oil has been produced as a result of bacterial decomposition of the remains of animals and plants (under high pressure) which got buried under the sea, millions of years ago. The hydrocarbons formed by decay of the micro-organisms rise through porous rocks until they are trapped by impervious rocks. If the region is uplifted during the passage of time, the oil trap will be found to lie under land. Oil in these deposits generally floats over salt water. The oil in the petroleum field is generally covered with a gaseous mixture known as natural gas.

The various components obtained from fractional distillation of petroleum are : asphalt (petroleum coke), lubricating oil, paraffin wax, fuel oil, diesel, kerosene, gasoline (petrol) and petroleum gas. In India various oil refineries are located at Barauni, Haldia, Chennai, Vishakhapatnam, Cochin, Mumbai, Digboi, Mathura, Guwahati and Koyali.

USES OF PETROLEUM

- Gasoline (petrol) is a motor fuel.
- Diesel oil is fuel for diesel engines.
- Fuel oil is a furnace fuel.
- Kerosene is household fuel, illuminant fuel and jet engine fuel.
- Lubricating oils are used for lubrication of machinery.
- Paraffin wax is used in manufacture of candles, water proofing, vaseline, fabrics.
- Petroleum coke can be used as a fuel and electrodes.
- Petroleum gas is used as a gaseous fuel, production of carbon black, hydrogen and carbon monoxide (used to make ammonia and methanol) and gasoline by polymerisation.



CONSERVATION OF PETROLEUM

Besides judicious use of oil and petroleum we can start thinking about other substitutes.

- Melvin Calvin was the first person to identify few plants whose products can be used in place of petrol and oil. The plants are able to convert substantial amount of photosynthates into latex which contains long chained liquid hydrocarbons which can be used directly or broken to hydrocarbons of chain length similar to ones in petrol. Various petroleum products can be obtained by cracking also.
- Even ethanol can be used as a fuel. In Brazil, alcohol is being used as motor fuel. Alcohol can be used as a fuel for automobiles either as 10-15 per cent blended with petrol or as entire fuel. Mixture is called gasohol. The crops which can be used for the production of alcohol are called energy crops.
- Continuous improvement in fuel efficiency of automobiles.
- Developing solar power machines and vehicles.
- To work on battery operated vehicles.
- Proper maintenance of vehicles.
- Regular cleaning of air filters.

To conclude we can say that, if coal and petroleum undergo complete combustion CO_2 , H_2O , oxides of nitrogen and sulphur are released. If incomplete combustion in insufficient oxygen occur, it leads to formation of carbon monoxide instead of carbon dioxide which is more harmful. Increase in carbon dioxide brings about greenhouse effect and global warming. Therefore, we need to use these resources i.e., coal and petroleum judiciously. Presently Euro I and Euro II norms for emission from vehicles are working towards reducing air pollution.

EURO NORMS

- EURO I & II Emission norms are prescribed CO (Carbon Monoxide), HC (Hydrocarbons) and NO (Nitrous oxide) levels set by the government which a vehicle would emit when running on roads. All the manufacturers need to implement the same for vehicles being manufactured from the date of implementation.
- Euro norms refer to the permissible emission levels from both petrol and diesel vehicles, which have been implemented in Europe. However in India, the government has adopted the Euro norms for available fuel quality and the method of testing. Euro-I norms in India are known as INDIA 2000 since it will be implemented from 1/4/2000. The norms equivalent to Euro-2 are called 2005 norms but these have not yet been specified by the Indian Government.
- The Euro norms require manufacturers to reduce the existing polluting emission levels in a more efficient manner by making certain technical changes.
- The following changes normally will be made by manufacturers in order to have a EURO I compliant car. Typically, the following areas would require attention: (a) carburetor retuning (b) secondary air intake (c) exhaust gas recirculation (d) catalyser capacity increase (e) trimetal coating in the catalyser.
- Changes for having a Euro II compliant vehicle require that the carburetor be replaced by an MPFI system i.e., a Multi-point Fuel Injection System.
- There are two basic types of engines, spark ignition and compression ignition engines. In the former, fuel ignition is triggered by an electric spark from a spark plug, while in the latter, atomized liquid fuel is injected with the help of a fuel pump and a nozzle into a cylinder full of hot compressed air, which results in ignition taking place. Larger cylinders which need more fuel require more than one injector, thus resulting in a multi-point fuel injection system.

SUSTAINABILITY OF NATURAL RESOURCES

The last few decades have seen an increasing realisation that the current pattern of development and consumption is unsustainable. In other words, the increasing burden we are placing on the world's natural resources and environmental systems cannot go on forever. Environmental problems such as climate change, the economic challenges of increasing energy prices and social issues like 25,000 people dying everyday from drinking polluted water are all examples of how we are living far beyond the capacity of the environment.



It is clear that many of the decisions we make will have an impact on everyone, both today and in the future. As we continue to develop it is important to do so in a way that meets everyone's needs without compromising the ability of future generations to meet their own needs. This is the concept of **Sustainable Development** : achieving social and economic progress while protecting and enhancing the environment.

In Securing the Future for Sustainable Development, there are four priority areas for action

- Sustainable consumption and production.
- Climate change and energy.
- Natural resources protection and environmental enhancement.
- Sustainable communities.

Sustainability is defined as meeting the needs of present generation without compromising the ability of future generations to meet their own needs. It is the intersection between three concentric circles: ecology, economy and society.

History of resource use has been a story of exploitation :

- Exterminating species.
- Formation of dams on rivers.
- Over-cutting timber.
- Over-harvesting fish.
- Over-developing landscapes.
- Polluting air.
- Contaminating water etc.

Sustainability means finding a way to accommodate our human needs without damaging the environment and even restoring damaged ecosystems so that they function somewhat like they once did. To do this we should try to :

- Use renewable resources like wind, solar energy, instead of non-renewable resources like fossil fuels.
- Use those resources which cause less harm to the environment.
- Cut back on the amount of natural resources specifically non-renewable resources we used, by reducing, reusing and recycling.

SUSTAINABLE FOREST MANAGEMENT

Forests and Climate Change

There is great concern that increasing levels of carbon dioxide and other greenhouse gases in the atmosphere are causing changes in the global climate. Forests are considered natural 'carbon sinks' because trees absorb carbon dioxide from the atmosphere as they grow, releasing oxygen and storing the carbon in their leaves and wood. In fact forests are a bit like a giant global air-purifier. They take **carbon dioxide** and turn it into wood and release clean **oxygen** for us humans and other animals to breathe.

Once a tree has been harvested, it ceases to absorb any more carbon dioxide. If the tree is buried or left to rot on the forest floor, this carbon dioxide will be released back into the atmosphere over time. However, newly regenerated or replanted trees will continue to absorb the carbon dioxide from the atmosphere again. Also, once the tree is made into wood products, like timber or paper, these products continue to store the absorbed carbon. This is another important reason for ensuring that timber and paper products are recycled whenever possible, instead of being placed into landfill.

Sustainable forest management includes :

- All timber production for domestic consumption and export should come from sustainable; managed natural forests.
- Regular monitoring of timber harvesting practices.
- More efficient wood use.
- Recycling.
- Promoting lower levels of consumption.
- Expose forest harvesting malpractices.



SUSTAINABLE CONSERVATION OF BIODIVERSITY

Biodiversity conservation is an investment that yields substantial local, national and global benefits. As a part of the larger effort to achieve sustainable development, conserving biodiversity requires fundamental changes in patterns and practices of economic development worldwide. Biodiversity conservation can be sustained only if.

- Public awareness and concern are substantially heightened.
- Action to conserve biodiversity is planned and implemented at a scale determined by ecological and social criteria.
- There is increased public participation.
- There is more integrative protected area management.
- Active participation of populations inside and around conservation sites, protected area allocation according to ecological representatives.
- There is establishment of wildlife corridors.
- There is combination of both exsitu (Conservation outside their natural habitats) and insitu. (Conservation in natural habitats) conservation.
- There is commitment and support from Govt. and private sectors.

WATER RESOURCES AND HYDROELECTRIC PROJECTS

The environmental consequences of water resources-related projects are a matter of great concern. Although hydroelectricity has many advantages, yet there are few set-backs. The increase of water level might provide a better habitat for fish but can destroy habitat of humans by flooding of land. In addition flooding can cause soil erosion, show impact on the vegetation of the area and cities located downstream.

Therefore there should be: .

- Proper Planning phases of hydroprojects.
- Environmentally sustainable dam building.
- Water harvesting.
- Rural development" efforts on water quality and quantity.
- Thinking of alternatives to dams.

A sufficient and sustainable supply of electricity to the world's population is one of today's greatest challenges. The current system of electricity production, including a 17% contribution of hydropower, is failing large parts of the population. Close to 2 billion people have no access to electricity, and on top of that, the reliance on fossil fuels such as coal, gas and oil is rapidly leading to **climate change**. Energy efficiency and renewable energy sources are the way forward. Yet the role of hydropower is not without controversy.

RENEWABLE ENERGY AND HYDROPOWER

Renewable energy is produced by transforming the natural energy flows of the Earth such as the sun, water, wind and biomass. These sources are permanently available and are non-polluting.

But in the case of large hydropower stations, is renewable energy truly sustainable?

The scale of the environmental damage created by the construction and operation of some hydropower stations is such that they should not be described as sustainable. And hydropower is not always emission free : it has been shown that shallow reservoirs in the tropics can emit substantial amounts of carbon dioxide and methane, two important greenhouse gases.

Besides the environmental impacts, the social and economic risks can be enormous. In developing countries in particular, the poorest people rarely benefit from large-scale hydropower dams. Instead, dams are often planned for export of electricity. The debate on hydropower and renewables is ongoing. There are often better, cheaper, less-destructive alternatives to building a large dam, whether to meet energy or water needs. These alternatives—from small-scale, decentralized water supply and new renewables, to large-scale efficiency and conservation options—have frequently been ignored.



N.C.E.R.T TEXT BOOK SOLUTIONS

Q.1 What changes can you make in your habits to become more environment friendly?

Ans. The most important means to make our habits more environment friendly are the three R's, i.e., Reduce, Recycle and Reuse.

(a) Reduce: The best thing is to reduce consumption and prevent wastage.

(i) Switch off the electric appliances when not in use.

(ii) We should check regularly the leaking taps to avoid wastage of water.

(iii) Reducing the wastage of food.

(iv) Use public transport for travelling instead of using private cars.

(v) Use bicycle for visits to the market or neighbourhood.

(b) Recycle: We should do separation of recyclable wastes from non-recyclable wastes. Recycling saves resources and helps to conserve environment in many ways.

(c) Resuse: Use reusable articles again and again. For example, carry bags, packing materials, plastic containers and other reusable articles should not be dumped away if they are uncontaminated and reusable.

Q.2 What would be the advantages of exploiting resources with short term aims?

Ans. Exploiting the resources with aiming short term benefits provide immediate advantages which can only meet our current needs. To overcome over exploitation of resources we must

(i) reduce our basic needs

(ii) avoid excessive use of food, water and other consumable items

(iii) avoid using non-biodegradable items

(iv) save electricity

Q.3 How would these advantages differ from the advantages of using a long term perspective in managing our resources?

Ans. Short term exploitation of natural resources meets the current demand and are beneficial only for the present generation but long term management of resources is aimed to fulfil the needs of future generations. Long term management of resources can be achieved by their sustainable use.

Q.4 Why do you think there should be equitable distribution of resources? What forces would be working against an equitable distribution of our resources?

Ans. Equitable distribution of resources will ensure benefits to poor as well as rich both kinds of people. The criteria for distribution must be made in such a way that the people who get abundant resources must not waste them. In our Country, money and power are two major factors which hinder the equal distribution of resources. Powerful and rich people take benefit of their influence and try to encroach upon the shares of poor people.

Q.5 Why should we conserve forests and wildlife?

Ans. There are economic and ecological reasons to conserve forests and wildlife. Economically forests are a good source of shelter, food, fodder and other valuable products like drugs, dyes and resins to people living in or out of the forests. Wildlife is useful for performing scientific research and used as gene bank for improvement of domesticated plants and animals. Ecologically they maintain the ecological balance of environment.

Q.6 Suggest some approaches towards the conservation of forests.

Ans. Some approaches regarding forest conservation are:

(i) Afforestation and reforestation

(ii) Controlled grazing



- (iii) Social forestry
- (iv) Agroforestry
- (v) Urban forestry
- (vi) Plantation of indigenous or exotic species to develop forests in all available land.
- (vii) Indiscriminate felling of trees for the purpose of timber must be reduced.
- (viii) Prevention of scraping and litter removal.
- (ix) Building of national parks, sanctuaries and biosphere reserves.

Q.7 Find out about the traditional systems of water harvesting management in your region.

Ans. The traditional system of water harvesting! management in our region are pits, lakes, ponds, ditches and wet land. These reservoirs store rainwater that is used for various purposes like agriculture, drinking and also help in recharge of ground water.

Q.8 Compare the above system with the probable system in hilly/mountainous areas or plains or plateau region.

Ans. In hilly/mountainous areas, check dams are constructed which are totally different from lakes and ponds as they store running water that is diverted to the required place. They are built across seasonally flooded gullies. The water in check dams does not remain stagnant for long hence they do not provide breeding grounds for mosquitoes and they do not get easily polluted by humans and animal wastes.

Q.9 Find out the sources of water in your region/locality. Is water from this source available to all people living in that area?

Ans. In our locality, water is available for people through two major sources:

- (i) The water is supplied by municipal corporation through pipes. It is obtained from rivers/canals. In many cases, piped water is pumped from ground by tube wells and stored in raised water tanks.
- (ii) The poor people obtain water through hand pumps.

Q.10 What changes would you suggest in your home in order to be environment friendly?

Ans.

- (i) Switching off lights and other electrical appliances if not required
- (ii) Use energy efficient lamps (CFLs) instead of traditional filament bulbs
- (iii) Use solar cookers, solar systems and solar heaters in place of electrical appliances
- (iv) Avoid using plastic bags and non-biodegradable materials
- (v) Increasing reuse of containers
- (vi) Separation of recyclable wastes from non-recyclable wastes prior to disposal

Q.11 Can you suggest some changes in your school which would make it environment friendly?

Ans.

- (i) Grow trees all around the play grounds along with boundary wall in school
- (ii) Make arrangement for water harvesting which can easily be managed at the roofs of classrooms
- (iii) School buses should run on CNG instead of diesel
- (iv) The fallen leaves of trees should be collected and converted into compost
- (v) Install solar energy panels to produce electricity
- (vi) Arrange awareness programmes among students through poster exhibitions and lectures

Q.12 We saw in this chapter that there are four main stake holders when it comes to forest and wildlife. Which among these should have the authority to decide the management of forest produce? Why do you think so?

Ans. The people living in and around the forest area should have the authority to decide the management of forest produce because the local people are well aware of the practices to use the resources in sustainable manner. These people have been using the forest resources since ancient times without harming or causing any environmental damage because they are aware that excessive use of forest produce will be detrimental for their own survival.



Q.13 How can you as an individual contribute or make a difference to the management of

(a) forest and wildlife (b) waterresources (c) coal and petroleum?

Ans. (a) For preserving forest and wildlife, I will not allow the cutting of trees and stop using animal products. I will make extensive campaigns for awareness among common people about the significance of forests and wildlife through various means.

(b) I will use water judiciously and prevent the wastage of water. I will also adopt the various possible water harvesting systems.

(c) I will try to minimise the use of coal in my house and suggest my friends and relatives to use nonpolluting fuels.

(d) I will use bicycle for shorter distances instead of motor vehicles. I will prefer public conveyance to save petroleum.

Q.14 What can you as an individual do to reduce your consumption of the various natural resources?

Ans. As an individual, I will adopt these measures to reduce the consumption of natural resources

(i) Use energy efficient CFL's instead of filament type electric bulbs

(ii) Switch off the electrical appliances when not in use

(iii) Prevent excess wastage of food

(iv) Prevent wastage of water by getting the leaking taps repaired

(v) Prefer to use renewable sources of energy

(vi) Use solar energy to conserve fossil fuels

(vii) Prefer to use the stairs instead of lift

Q.15 List five things you have done over the last one week to

(a) conserve our natural resources (b) increase the pressure on our natural resources

Ans. Answer to this should be given by students according to their activities of last one week.

Hints:

(a) (i) I have not wasted food. (ii) I have used public vehicles instead of using own car. (iii) Reduced consumption of water by closing the tap to prevent over flow of water in bucket. (iv) I used only as much of electricity as was required. (v) I convinced my mother to use solar cooker for cooking food.

(b) (i) I went to market by car instead of bicycle. (ii) I did not close the tap while brushing my teeth. (iii) forgot to switch off my room lights last two nights. (iv) I asked my gardener to burn dry leaves and polythene bags. (v) I used washing machine dryer to dry wet clothes.

Q.16 On the basis of the issues raised in this chapter, what changes would you incorporate in your lifestyle in a move towards a sustainable use of our resources?

Ans. (i) Follow the principles of three R's—reduce, recycle and reuse

(ii) Walk or use the cycle to cover shorter distances

(iii) Use stairs for 3 or 4 floors instead of use of a lift

(iv) Use more warm clothes in winter rather using room heaters

(v) Stop using products made from animal skin

(vi) Use CFL's instead of traditional filament type bulbs

(vii) Use solar cookers and solar water heater

(viii) Stop using polythene bags and other non-biodegradable wastes

(ix) Undertake tree plantation twice a year



EXERCISE – I**NTSE /OLYMPIAD /FOUNDATION PROBLEMS****MULTIPLE CHOICE QUESTIONS**

1. Major programme to replenish forests is :
(A) Silviculture (B) Monoculture
(C) Agriculture (D) Apiculture
2. Deforestation causes :
(A) Soil erosion (B) More floods
(C) Rainfall (D) All the above
3. If all the plants of the earth die suddenly all the animals die due to deficiency of :
(A) Food (B) Shade
(C) Oxygen (D) Shelter
4. The concept of 'Biosphere Reserve' was evolved by :
(A) UNESCO (B) Govt. of India
(C) Botanical Survey of India (D) Zoological Survey of India
5. the area reserved for the welfare of wildlife is called :
(A) National park (B) Botanical garden
(C) Sanctuary (D) Forest
6. Chipko movement is concerned with :
(A) Forest conservation (B) Plant breeding
(C) conservation of natural resoures (D) Project tiger
7. Animals and plants are best protected in :
(A) Zoos (B) Botanical gardens
(C) National parks (D) Sanctuaries
8. New approach to conservation is the establish ment of :
(A) Sanctuaries (B) Biosphere reserves
(C) National parks (D) Reserve forests
9. Forests and wildlife are :
(A) Renewable resources (B) Non-renewable resources
(C) Inexhaustible (D) None of these
10. Fossil fuels and metallic minerals are :
(A) Renewable resources (B) Inexhaustible resources
(C) Non-renewable resources (D) None of these



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11. The biomass fuel which is burned to release energy can be :
(A) Solid only (B) Liquid only
(C) Both solid and liquid (D) Solid, liquid and gas
12. Which group of vertebrates comprises the highest number of species ?
(A) Birds (B) Mammals
(C) Fishes (D) Reptiles.
13. In our country percentage of land under forest is about:
(A) 20% (B) 19%
(C) 25% (D) 30%
14. Wildlife is destroyed mostly by :
(A) Lack of proper care (B) Mass scale hunting
(C) Destruction of natural habitats (D) Natural calamity.
15. Deforestation may reduce the chances of :
(A) Frequent cyclones (B) Soil erosion
(C) Rainfall (D) Landslides.

FILL IN THE BLANKS

- Most biotic resources are
- Deforestation causes of plant, animal and microbial species.
- Resources which can be replenished are called
- is one of the programmes started to replenish forests.
- Bharatpur bird sanctuary is in
- Three fossil fuels are coal, petroleum and
- is also known as rock oil.

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

- | | | | | | | |
|-------|------|-------|-------|-------|-------|-------|
| 1. B | 2. B | 3. C | 4. A | 5. A | 6. A | 7. C |
| 8. B | 9. A | 10. C | 11. D | 12. B | 13. C | 14. C |
| 15. C | | | | | | |

FILL IN THE BLANKS

- | | | | |
|--------------|----------------|------------------------|-----------------|
| 1. Renewable | 2. Depletion | 3. Renewable resources | 4. Silviculture |
| 5. Rajasthan | 6. Natural gas | 7. Petroleum | |



EXERCISE – II**PRACTICE FOR SUMMATIVE ASSESSMENT****VERY SHORT ANSWER QUESTIONS**

1. What is silviculture ?
2. Define conservation.
3. Name one national park and one bird sanctuary developed in our country to protect wildlife, rare animals and birds.
4. When was project tiger started ?
5. What are fossil fuels? Name any two fossil fuels.
6. Name any two constituents 'of petroleum which are not used as fuels.
7. Name two major elements present in coal.
8. Write another name for petroleum.
9. Name one of the prominent leaders of chipko movement.
10. Who was Amrita Devi Bishnoi ?

SHORT ANSWER QUESTIONS

1. Why is replenishment of forests necessary ?
2. How do forests affect the water cycle ?
3. Discuss various benefits achieved through silviculture.
4. What is potable water ? State any four of its necessary characteristics.
5. Differentiate between arithmetic progression and geometric progression in terms of food and population.

LONG ANSWER QUESTIONS

1. Discuss various effects of unplanned technological growth.
2. Are there any alternatives to dams ? Discuss.



EXERCISE – III
PRACTICE FOR SUMMATIVE ASSESSMENT

- Ever increasing human population, urbanization & industrialization have led to–
(A) over exploitation (B) under exploitation (C) monetary exploitation (D) All
- Petroleum is a complex mixture of compounds of –
(A) Hydrogen & carbon (B) Lead & Zinc
(C) Chloride & Flouride (D) Sodium & Chloride
- The word forest has been derived from a Latin word –
(A) Foris (B) Floris (C) Forestry (D) Flora & Fauna
- Rains in India are largely due to
(A) Monsoon (B) Day & night change (C) Humidity differences (D) all
- Which among them is not a water harvesting method.
(A) Kulhs (B) Ahars (C) Khadins (D) Sigri
- Which among them is a local system of canal irrigation in Himachal pradesh.
(A) Kulhs (B) Ahars (C) Khadins (D) Sigri
- Rain water harvesting not only increases water availability but also checks the declining –
(A) Soil erosion (B) Water table (C) Deforestation (D) Extinct species
- Tribal women of which village started 'Chipko movement'?
(A) Reni in Garhwal (B) Dehradun
(C) Rajasthan (D) West Bengal
- Which among them is the National Award for wildlife conservation –
(A) Savitri devi (B) Amrita devi (C) Amrita Rao (D) A.K. Banerjee
- What was grass root cause of 'Chipko Andolan'
(A) Industrialization (B) effort to end the alienation of people from their forests
(C) Deforestation (D) All
- Which group of bacteria found in human intestines is also present in Ganga water –
(A) Bacillus (B) Vibrio (C) Coliform (D) Coccus
- Which term denote following – using the sanse resource again in the same form
(A) Reduce (B) Recycle (C) Reuse (D) Preserve
- Which among the three R's describe following activity best- "Switch off unnecessary light & fans".
(A) Reduce (B) Recycle (C) Reuse (D) All
- Which among the following is long term environment friendly decision – "STOP" -
(A) Cutting of trees (B) Pollution (C) Killing tigers (D) None
- One of them is not a stake holder –
(A) Forest department (B) Bidis factory owner
(C) Bishnoi community (D) NASA
- End product of incomplete combustion of fossil fuel is –
(A) CO (B) CO₂ (C) SO₂ (D) H₂O
- Pollution can be measure by
(A) p.p.m. (B) Molarity (C) pH (D) All
- Extinction of a rare tribal species due to natural disaster like tsunami is loss of –
(A) Society (B) Individual (C) Population (D) Biodiversity
- Which is the social problem associated with big dams –
(A) Public money is wasted (B) displacement of million of tribals
(C) People meeting place is disturbed (D) deforestation & loss of biodiversity
- Water quality criteria for Designated best use in India for drinking purpose –



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- (A) Total coliform 50 or less than in 100 ml
(C) Total coliform 5 or less than in 100 ml

- (B) Total coliform 500 or less than in 100 ml
(D) Not considered

EXERCISE – IV

PRACTICE FOR SUMMATIVE ASSESSMENT

SECTION-A

● Fill in the blanks

- _____ means development which meets the needs of the present generation as well as of the future generation.
- Recycling and reuse is an example of _____.
- _____ important source of resource for the forest development.
- Amrita Devi Bishnoi National award is for _____.
- Another name for Chipko movement is _____.
- CITES is _____.
- The main purpose of water harvesting structure is not to hold the surface water but to _____.
- Combustion of fossil fuel in presence of less oxygen leads to formation of _____.
- Conservation of fossil fuel depends upon _____.
- Oxides of _____ & _____ are poisonous at high concentration.

SECTION-B

● Multiple choice question with one correct answers

- Which is preserved in National Park
(A) Flora (B) Fauna (C) Both (A) & (B) (D) None of these
- Decrease in species diversity in tropical countries is mainly due to:
(A) Urbanisation (B) Pollution (C) Deforestation (D) Soil erosion
- Wild life conservation means the protection & preservation of:
(A) Ferocious wild animal only
(B) Wild plant only
(C) Non-cultivated plant & non-domesticated animal
(D) All the above living in natural habitat
- Which of the following animal has become extinct in India:
(A) Wolf (B) Rhinoceros (C) Hippopotamus (D) Cheetah
- Domestic cooking gas is filled with:
(A) Alcohol (B) Diesel oil
(C) Liquid petroleum gas (D) Coal gas

SECTION-C

● Multiple choice question with one or more than one correct answers

- Resource which can never run out are called:
(A) Renewable resources (B) Inexhaustible resources
(C) Non-Renewable resources (D) Exhaustible resources
- Role of 'R' in managing resources is:
(A) Reduce (B) Recycle (C) Reuse (D) Reproduce
- Which of the following are non-renewable resource:
(A) Forest (B) Water (C) Wind (D) Coal
- Ancient water harvesting structure of Bihar are:
(A) Ahars (B) Pynes (C) Kattus (D) Kulhs

SECTION-D



Assertion & Reason

Instructions: In the following questions an Assertion (A) is given followed by a Reason (R). Mark your responses from the following options.

- (A) Both Assertion and Reason are true and Reason is the correct explanation of 'Assertion'
- (B) Both Assertion and Reason are true and Reason is not the correct explanation of 'Assertion'
- (C) Assertion is true but Reason is false
- (D) Assertion is false but Reason is true

1. **Assertion:** Regions in Gangetic plains are very fertile.
Reason: It has mainly alluvial soil.
2. **Assertion:** Every biological system resists a change and wants to remain in state of equilibrium.
Reason: Climax communities of an ecosystem are produced after several changes it has gone through succession.
3. **Assertion:** Conservation of biological diversity under natural condition is in situ conservation.
Reason: Increase of Manipur deer from 17 animals to 150 in Calcutta and Delhi zone is one of an example of these.

SECTION-E**Match the following (one to one)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. Only One entries of column-I may have the matching with the same entries of column-II and one entry of column-II Only one matching with entries of column-I

1. Column I

- (A) Kulhs
- (B) Kattas
- (C) Tals
- (D) Kadin

Column II

- (P) Karnataka
- (Q) Maharashtra
- (R) Rajasthan
- (S) Himachal Pradesh

2. Column I

- (A) Environment problem
- (B) Economic problem
- (C) Social problem
- (D) Health problem

Column II

- (P) Public money swallowed
- (Q) Deforestation & loss of biodiversity
- (R) Displaced present & tribal
- (S) Malnutrition and Obesity

SECTION-F**Comprehension**

Biodiversity is the variety of life: the different plants, animals and micro organism, their genes and the ecosystem of which they are a part biodiversity is often defined as the variety of all forms of life, from gene to species, through to the broad scale of ecosystems.

Extinction is the gravest aspect of the biodiversity crisis : it is irreversible.

British ecologist Norman Myres defined the biodiversity hotspot concept in 1988 to address the dilemma that conservationists face.

1. Name some extinct organisms.
2. Name some hot spots of the world.
3. Extinction is irreversible. Explain
4. Who introduced the concept of hotspot and when?



Answers

Exercise-III

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (A) | 2. (A) | 3. (A) | 4. (A) | 5. (D) |
| 6. (A) | 7. (B) | 8. (A) | 9. (B) | 10. (B) |
| 11. (C) | 12. (C) | 13. (A) | 14. (C) | 15. (D) |
| 16. (A) | 17. (D) | 18. (D) | 19. (B) | 20. (B) |

Exercise-IV

1. Sustainable development
3. Monoculture
5. Hug the tree movement
7. Recharge the ground water
9. Efficiency of our machines

Section-A

2. Conservation
4. Wild life conservation
6. Convention on international trade in endangered species
8. CO₂
10. sulphur & Nitrogen

Section-B

- | | | | | |
|--------|--------|--------|--------|--------|
| 1. (C) | 2. (C) | 3. (D) | 4. (D) | 5. (C) |
|--------|--------|--------|--------|--------|

Section-C

- | | | | |
|-----------|--------------|--------------|-----------|
| 1. (A, B) | 2. (A, B, C) | 3. (A, B, C) | 4. (A, B) |
|-----------|--------------|--------------|-----------|

Section-D

- | | | |
|--------|--------|--------|
| 1. (A) | 2. (B) | 3. (C) |
|--------|--------|--------|

Section-E

- | | |
|---------------------------------------|---------------------------------------|
| 1. (A)-(S), (B)-(P), (C)-(Q), (D)-(R) | 2. (A)-(Q), (B)-(P), (C)-(R), (D)-(S) |
|---------------------------------------|---------------------------------------|



EXERCISE – V**PRACTICE FOR OLYMPIAD ASSESSMENT**

1. Environment is formed of :
(A) Only biotic components (B) Only abiotic components
(C) Both of these (D) None of these
2. BOD stands for:
(A) Biological oxygen demand (B) Biochemical oxygen demand
(C) Biochemical organic decomposition (D) Biological organic decomposition
3. Environment day falls on:
(A) 28th February (B) 23rd March (C) 5th June (D) 16th September
4. Development with both intragenerational and intergenerational quality is called:
(A) Sustainable development (B) Unsustainable development
(C) Economic development (D) Sustainable consumption
5. Sustainable consumption can be achieved by:
(A) 3-R approach (B) Reducing the use of fossil fuels
(C) By using alternative sources of energy (D) All of these
6. Joint forest management is an example of :
(A) Political equality (B) Participatory approach
(C) Food stabilization (D) Economic equality
7. Chipko movement was led by :
(A) KM. Munshi (B) Sunder Lal Bahuguna
(C) Panduranga Hegde (D) Menaka Gandhi
8. Which form of coal is hardest and with maximum carbon content ?
(A) Lignite (B) Peat (C) Anthracite (D) Pearl
9. Which of the following is an inexhaustible natural resources?
(A) Forests (B) Minerals (C) Coal (D) Water
10. Which of the following is an exhaustible natural resources?
(A) Solar radiation (B) Air (C) Minerals (D) Water
11. The quality of environment can be improved by
(A) Deforestation (B) Overuse of natural environment
(C) Erosion (D) Conservation
12. Maximum petroleum is used in
(A) Agriculture (B) Shipping (C) Industries (D) Transportation
13. Deforestation causes



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- (A) Soil erosion (B) Pollution (C) No floods (D) None of these
- 14.** Ecological imbalance in the biosphere is created by
 (A) Cutting of forests (B) Conservation of forest
 (C) Production of more paper (D) Both (A) and (C)
- 15.** Floods can be prevented by
 (A) Cutting the forests (B) Afforestation (C) Tilling the land (D) Removing the top soil
- 16.** Ganga Action Plan was started in
 (A) 1975 (B) 1985 (C) 1995 (D) 2005
- 17.** Which of the following are the stakeholders of the forests?
 (A) Local people (B) Industries (C) The government (D) All of the these
- 18.** Amrita Devi Bishnoi National Award is rendered for
 (A) water conservation (B) wildlife conservation (C) soil conservation (D) none of these
- 19.** Chipko movement was started in
 (A) Uttarakhand (B) Himachal Pradesh (C) Uttar Pradesh (D) Madhya Pradesh
- 20.** Arabari project was started in 1972 in
 (A) Bihar (B) Maharashtra (C) West Bengal (D) Delhi
- 21.** Who was the mastermind of Arabari project?
 (A) Sunderlal Bahuguna. (B) Jyoti Basu (C) A.K. Banerjee (D) None of these
- 22.** One of the world's most critical watersheds are found in
 (A) Himalayas (B) Aravali (C) Vindhyachal. (D) None of these
- 23.** Khadin system of water harvesting is found in
 (A) Rajasthan (B) Himachal Pradesh (C) Haryana (D) Gujarat

ANSWER KEY

Q ue.	1	2	3	4	5	6	7	8	9	10	11	12
A ns.	C	A	C	A	A	B	B	C	D	C	D	D
Q ue.	13	14	15	16	17	18	19	20	21	22	23	
A ns.	A	D	B	B	D	B	A	C	C	A	A	

